

Missouri Department of Transportation



# **STORMWATER POLLUTION PREVENTION PLAN**

January-August 2014





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## 806.8.1 INTRODUCTION TO THE STORMWATER PERMIT AND SWPPP

Provisions of the federal Clean Water Act and related state rules and regulations require stormwater permits where construction activities disturb ~~greater than~~ one acre or more over the life of a project as part of a common plan or sale. MoDOT has a general [State Operating Permit](#), obtained from the [Missouri Department of Natural Resources \(DNR\)](#), which allows for land disturbance activities associated with highway, bridge and compensatory mitigation construction as well as maintenance activities related to the upkeep of these features. The permit stipulates that MoDOT will ~~follow~~ develop a project stormwater pollution prevention plan (SWPPP) describing ~~ertain~~ erosion and sediment control guidelines and install temporary and permanent erosion and sediment control measures.

Locally sponsored federal aid projects involving an acre or more of land disturbance will need to obtain their own permits and develop effective SWPPPs. In some instances cities, counties and other government entities may already possess their own State Operating Permit and, in that case, must comply with their own SWPPP.

~~Locally sponsored federal aid projects that are performed on MoDOT right of way and are using MoDOT's land disturbance permit are required to comply with MoDOT Standard Specifications, and therefore, must follow this Stormwater Pollution Prevention Plan (SWPPP). When working adjacent to MoDOT right of way, cities, counties and other government entities may already possess their own State Operating Permit and, in that case, must comply with their own SWPPP.~~

There are instances where contractors may have to obtain their own permits for work involving borrow and excess (waste) disposal areas, and in some instances when portable plants are used. (See [Fig. 806.8.1](#) for details about the permitting requirements of these scenarios.) Also, in a few rare cases, MoDOT may require contractors to obtain their own individual State Operating Permit for land disturbance activities even though the project is being constructed on MoDOT right of way. These unique situations will normally be Design/Build projects that are funded by MoDOT, but totally managed by the contractor.

The purpose of the SWPPP is to ensure the design, implementation, management and maintenance of Best Management Practices (BMPs) reduce the amount of sediment and other pollutants in stormwater discharges associated with the land disturbance activities, comply with the Missouri Water Quality Standards, and ensure compliance with the terms and conditions of the general permit.

The following documents were used in the preparation of this SWPPP:

- **Best Management Practices for Erosion and Sediment Control**, (Report No. FHWA-FLP-94-005) published by the United States Department of Transportation (1995)
- **Stormwater Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices**, (Document number EPA 832-R-92-005) published by the United States Environmental Protection Agency (1992).
- **Protecting Water Quality: A field guide to erosion, sediment and stormwater best management practices for development sites in Missouri.**
- **Missouri Standard Specifications for Highway Construction (most recent edition)**
- **Missouri Department of Transportation Engineering Policy Guide**
- **Menu of BMPs – United States Environmental Protection Agency –** ([http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=min\\_measure&min\\_measure\\_id=4](http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=min_measure&min_measure_id=4))

A typical MoDOT project involves the implementation of many documents, processes, and standard operating procedures. These various processes and procedures are of such detail that it is impossible to include in this brief summary of BMPs. Pollution from stormwater can be reduced by the implementation of the BMPs, construction techniques, and site management measures that are articulated in this document. However, pollution from stormwater will also be reduced by the issuance of *Change Orders*, *Letters/Memos of Notification*, *Order Records* and *Contractor Performance Reports*. Changes that occur as a result of directives to contractors will usually be documented by *Document Records* and other various products and reports produced by a computer program called *Site Manager*. Lastly, a *Semi-Final Inspection Report* can serve to identify post-construction measures that will ensure permit compliance and water quality protection.

In addition to these contract management tools, MoDOT conducts annual stormwater permit compliance training for construction site inspectors, resident engineers, designers and other personnel, including contractors and consultants. The information distributed in this class goes above and beyond the scope of this Statewide SWPPP document. Many effective BMPs and construction techniques are discussed during this training, but may not yet appear in this document.

These and other unique MoDOT tools must be considered elements of a SWPPP because they all result in implementation of measures that cause or caused a resultant action to occur on a construction project.

## 806.8.2 SITE DESCRIPTION & PROJECT-SPECIFIC INFORMATION

~~EPG 237.1 Plan Details. MoDOT Form 806.8.2 describes outlines the project-specific information that is required to be included in all plans that are used by contractors to construct completed for all MoDOT projects involving land disturbance of one acre or more. Also required, and denoted at the bottom of Form 806.8.2, is the development of a project overview map, or maps, depicting the project location/alignment with enough detail to show waters of the United States within 1 mile of the project. These named waters of the U.S. are typically illustrated on U.S.G.S. topographic maps, and some county or city maps, as blue line streams or named impoundments, such as lakes and reservoirs, as well as tributaries to these bodies of water. Along with this information, MoDOT develops project-specific erosion and sediment control plan sheets (site maps) based on first-hand knowledge of site conditions and guidance described within this narrative SWPPP. Development of project-specific erosion and sediment control plans is described within EPG 806.8.3 Developing/Amending Project-Specific Project Plans. All projects are constructed from a set of design plans that are generated by MoDOT designers or consultants. The plans show all existing topographic features, buildings, roadways and drainages, as well as right of way limits. Within a project's design plans are erosion and sediment control plans which serve as the site maps for the project to be used in combination with this narrative SWPPP. These plans contain sufficient information to be of practical use to contractors and site construction workers to guide the installation of BMPs in the interim and final stages of construction. Site plans are on location at active MoDOT job sites when MoDOT's construction inspector or the contractor superintendent is on site. These plans will usually include hand written notes showing the locations of temporary and in some cases, permanent BMPs.~~

~~Contract plans shall include erosion and sediment control measures that are sufficient to protect streams, lakes, wetlands and private land adjacent to MoDOT right of way, and the location of most of these controls will be depicted on the plan sheets. The exact location of the controls that are shown on plan sheets will be determined in the field by the engineer or inspector. Temporary control measures shall be coordinated with permanent control measures to assure economical, effective and~~

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~~continuous erosion and sediment control. Construction of permanent erosion control measures that may contribute to the control of siltation, shall be accomplished at the earliest practicable time.~~

~~MoDOT site maps (erosion and sediment control plans) are to include:~~

- ~~• Direction(s) of stormwater flow and approximate slopes anticipated after grading activities~~
- ~~• Areas of soil disturbance and areas that will not be disturbed~~
- ~~• Location of major structural and non-structural BMPs~~
- ~~• Locations where stabilization practices are expected to occur~~
- ~~• Locations of on and/or off site material, waste, borrow or equipment storage areas~~
- ~~• Locations of all waters of the U.S.~~
- ~~• Locations where stormwater discharges to a surface water~~
- ~~• Areas where final stabilization has been accomplished and no further construction phase permit requirements apply~~

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Every MoDOT project with one or more acres of total land disturbance must complete the following project-specific site information and retain it as part of the SWPPP. See [Figure 806.8.2](#) for an example of how to complete this form.

MISSOURI DEPARTMENT OF TRANSPORTATION  
[Form 806.8.2](#) Project-Specific SWPPP Information ~~Form 806.8.2~~

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Project Number: _____	County: _____	Route: _____
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Project Description: \_\_\_\_\_

Estimated Project Start Date: \_\_\_\_\_

Estimated Project Completion Date: \_\_\_\_\_

RE Name: \_\_\_\_\_

Erosion and Sediment Control Inspector(s) Name(s): \_\_\_\_\_

Primary Contractor(s) Name(s): \_\_\_\_\_

Erosion and Sediment Control Contractor(s) Name(s): \_\_\_\_\_

Seed and Mulch Contractor(s) Name(s): \_\_\_\_\_

Total Anticipated Disturbed Acreage for the Project: \_\_\_\_\_

Primary Receiving Water(s) for the Project: \_\_\_\_\_

Location of Public Notification Sign(s) (Note: Must be Viewable to the Public): \_\_\_\_\_

Additional Project Notes: \_\_\_\_\_

404/401 Permit Required/Obtained for this Project?  Yes  No

**Attach a map or maps depicting the project location/alignment with enough detail to show waters of the United States within 1 mile of the project.**

### **806.8.3 DEVELOPING/AMENDING PROJECT-SPECIFIC PROJECT PLANS**

EPG 237.1 Plan Details describes the information that is to be included in all plans used by contractors to construct MoDOT projects. All projects are constructed from a set of project-specific design plans that are generated by MoDOT designers or consultants. The plans show all existing topographic features, buildings, roadways and drainages, as well as right of way limits. Within a project's design plans are erosion and sediment control plans which serve as the site maps for projects involving one acre or more of land disturbance. These site maps are to be used in combination with this narrative SWPPP to manage erosion and sediment control on MoDOT projects. These plans contain sufficient information to be of practical use to contractors and site construction workers to guide the installation of BMPs in the beginning, interim and final stages of construction. Up-to-date site maps are to be on location or electronically accessible at active MoDOT job sites when MoDOT's construction inspector or the contractor superintendent is on site. In lieu of paper copies, site maps can be maintained in digital format and accessed by electronic devices.

Though erosion and sediment control plans are developed by MoDOT designers and/or consultants, it is highly recommended that design and construction personnel work collaboratively to develop a strategy to control erosion, sediment and stormwater for applicable projects. There should generally be two sets of erosion and sediment control plans developed for projects with one acre or more of land disturbance. One set should be developed to depict existing site topography with outfall and perimeter protection BMPs, such as sediment basins, sediment traps, Type C berms, silt fence, etc., that will need to be installed prior to starting land disturbance of the site. The second set will generally show final project grade and BMPs that are envisioned during project construction and upon completion of final grading. The location of designed BMPs will be illustrated on the plan sheets; however, the exact location of BMPs will be determined in the field by the engineer or inspector.

Contract plans shall include erosion and sediment control measures that are sufficient to protect rivers, streams, lakes, ponds, wetlands and private land adjacent to MoDOT right of way.

MoDOT site maps (erosion and sediment control plans) are to include:

- Direction(s) of stormwater flow and approximate slopes anticipated after grading activities
- Areas of soil disturbance and areas that will not be disturbed
- Location of major structural and non-structural BMPs
- Locations where stabilization practices are expected to occur
- Locations of on and/or off-site material, waste, borrow or equipment storage areas
- Locations of all waters of the U.S.
- Locations where stormwater discharges to a surface water
- Areas where final stabilization has been accomplished and no further construction-phase permit requirements apply

Due to project phasing, all erosion and sediment control BMPs shown on project plans will not be installed until needed, based on site conditions. Therefore, for protection against regulatory scrutiny, designers or inspectors should note on erosion and sediment control sheets that all devices will be installed as necessary based on the discretion of project personnel. Inspectors can also create a clean set of plans, with no BMPs depicted, as the working copy for SWPPP purposes and add/remove only installed devices. A legend should be created for installation and removal of BMPs. BMPs should be highlighted and dated as they are installed or removed. It is important that site maps reflect BMPs that are actually on the ground at any given time, so plan sheets shall be properly updated each time

BMP additions and/or removals take place on the project. Example erosion and sediment control site plans can be found in Fig. 806.8.3.

The engineer shall require modifications to the erosion and sediment controls whenever the:

- Design of the construction project has changed in a fashion that could impact the quality of stormwater discharges;
- MoDOT inspections indicate deficiencies in individual BMPs;
- MDNR/EPA notifies MoDOT of erosion and sediment control deficiencies on site;
- Erosion and sediment controls are determined to be ineffective in significantly minimizing or controlling erosion and sedimentation;
- MDNR determines violations of Water Quality Standards have occurred.

### **806.8.3.1 Shoulder Addition Project Plan Development and Implementation**

Shoulder addition projects involving land disturbance of an acre or more can be particularly challenging to design, bid and implement BMPs. Design and construction personnel should collaborate to establish typical, desired BMP layouts for outfall and perimeter protection. These layouts should then be illustrated on a “Typical” erosion and sediment control plan as detailed plan sheets are not usually developed for these projects (There are a few exceptions to this when right of way acquisition or extensive grading is required). Designers will then estimate a quantity of BMPs necessary to construct the project. The estimated quantity of each type of BMP can be expressed in a table on the quantity sheet to be included in the contract plans for contractors.

In addition, like other land disturbance projects of an acre or more, shoulder addition projects are required by permit to have a site map depicting the location of all installed BMPs. If a full set of plan sheets is not developed, an acceptable practice for shoulder addition project site maps is to develop aerial photography sheets of the project corridor at a scale of 1”=200’, labeling named bodies of water, intersecting routes and county roads, and labeling log miles every 0.5 mile for the project (depicting tick marks every 0.1 mile is recommended for better accuracy). If full survey data was collected for the project, the log mile stationing may be set up precise based on survey data. Full surveys are not typical for shoulder addition projects, so a “rough” log mile stationing may be set up for the simple purpose of identifying approximate BMP locations to enhance communication, illustration and documentation for inspectors and contractors. The aerial sheets will not be included as part of the contract documents, but will be given directly to the Resident Engineer along with other supplemental project documents.

It is important to be aware that all designed BMP quantities may have to be adjusted depending on the contractor’s selected method of shoulder construction. Any expected adjustment in BMP quantities or implementation should be expressed to the prime and subcontractor, if applicable, during the erosion and sediment control discussion at the project preconstruction conference.

### **806.8.4 SITE INSPECTIONS AND REPORTS**

The resident engineer or inspector is responsible for environmental matters on MoDOT projects. As such, the engineer or inspector shall routinely inspect the installation, condition and functionality of erosion and sediment controls. If allowable due to right-of-way constraints, receiving streams shall be inspected for off-site sediment deposits for 50 feet downstream of project outfalls. Routine inspections are to be conducted at a minimum frequency of once every 7 calendar days. Additional, post-runoff inspections must occur within 48 hours if the runoff event ceases during a normal work day and within 72 hours, on the next business day, if the runoff event ceases during a non-work day

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such as weekends or state recognized holidays. A runoff event is defined as an event that causes runoff to occur on the job site and could result from rainfall or snow or ice melt. If there are consecutive days of measurable rainfall and/or runoff, these can be considered one event and precipitation totals should be tracked on a daily basis and an event total recorded. Since these consecutive days are considered to be one event, a post-runoff inspection should be done after the rain/runoff ceases; however, general observations should be made daily, especially with regard to outfall BMPs, to ensure BMPs are performing to the desired level. If rainfall or snow/ice melt is not sufficient to cause runoff, inspection reports do not need to be completed until the next required 7-day inspection.

MoDOT Form 806.8.4, MoDOT Land Disturbance Inspection Record, will be used for weekly and post-runoff inspections. This form has been developed as a guide to assist the inspector with permit compliance, while also requiring a general narrative description of current site conditions observed by the inspector at the time of inspection. The inspection reports shall be signed by the inspector and the engineer. The engineer or inspector will keep a log of all inspections made on the project.

The engineer or inspector will ensure that rainfall measurements are made for the job site and routinely monitor weather forecasts to recognize when predicted weather may threaten the construction site and when runoff has occurred. If the weather forecasts indicate storms may impact the project site, project personnel should evaluate whether or not the site has adequate BMP protection and is prepared to receive runoff and sediment.

Areas of the project that meet the final stabilization requirements (i.e., 70% permanent vegetative cover over 100% of the area, rock covered, paved, etc.) no longer require inspection, but casual observations should be made to ensure erosion problems don't arise.

The engineer or inspector shall notify the contractor within 24 hours if any controls are found to be improperly installed, in disrepair, or are not functioning at the desired level of effectiveness. **Any deficiencies noted shall be corrected within 7 calendar days;** however, the engineer and inspectors may require immediate attention and issue various directives by other means discussed in EPG 806.8.1 Introduction to the Stormwater Permit and SWPPP. Directives to the contractor shall be noted in project records, which shall be available for review by DNR upon request. **In instances where weather conditions make it impossible to correct deficiencies within 7 days, the engineer or inspector will document site conditions in the inspection reports. This documentation will include a written description and pictures illustrating the adverse conditions. Brief documentation of adverse conditions should take place daily until conditions improve. As soon as weather and site conditions become favorable, corrections to deficient BMPs shall be made.**

MoDOT performs environmental compliance training for construction site inspectors, resident engineers, designers and other personnel, including contractors and consultants, to ensure that erosion and sediment control inspections are being conducted in a consistent fashion statewide. The individual who performs the training is organizationally located in MoDOT's Environmental and Historic Preservation Section and does not have supervisory authority over the construction personnel who perform inspections. However, the same individual who performs training has the responsibility of performing statewide audits of construction sites to ensure that SWPPPs are being followed to the extent that off-site contamination does not occur. This individual will usually visit every construction site involving an acre or more of land disturbance at least once per year and meet with MoDOT resident engineers, inspectors and contractors to evaluate the land disturbance elements of the project and to ensure consistency of inspections. In cases where deficiencies are identified, the resident engineer or inspector has the responsibility to see that the deficiencies are corrected.

As part of the project inspection and compliance management process, the project's current authorized, open-erodible and disturbed acreage totals shall be recorded in Sitemanager when contractor pay estimates are run. These acreage totals are used to fulfill MoDOT's permit requirement to provide a list of statewide active land disturbance sites, one acre or more, to MDNR on a quarterly basis, every January, April, July and October. Also included within each report is the project name, location, description, primary receiving water(s), number of acres disturbed, percent completion and projected date of completion.

Primary receiving waters are named rivers, streams, lakes, etc. (e.g., Black River, Skull Lick Creek, Flat Branch, Longview Lake). If the project doesn't drain directly to named bodies of water, the inspector should list "Unnamed Tributary to" and then the named body (bodies) of water the project runoff would eventually end up within. Some urban projects will discharge to city stormwater systems. In this case, if the body of water the storm drain discharges to is unknown, simply list "Municipal Storm Sewers" and identify the entity if possible (e.g., MSD Municipal Storm Sewers).

*(Note: There are scenarios associated with the use of borrow and excess (waste) disposal areas, as well as portable plants, when the contractor may be responsible for site inspections. Please refer to Fig. 806.8.1 for inspection responsibilities in these scenarios.)*

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### **806.8.3-5 DRAINAGE AREAS & HOUSEKEEPING**

In compliance with the Missouri Clean Water Law (Section 644.051), neither MoDOT nor MoDOT's contractors shall pollute any waters of the state, or place, cause, or permit to be placed, any water contaminant in a location where it is reasonably certain to cause pollution of any waters of the state. To comply with this law, proper preventive measures and good housekeeping shall be maintained on job sites. Job site litter, construction debris and sanitary waste should be controlled. All litter shall be placed in appropriate containment receptacles. The use of portable toilets may be necessary to control sanitary waste in some situations. If used, these facilities shall be adequately placed and maintained so as not to cause a safety or environmental concern. If hazardous waste is generated or encountered on a job site, the MoDOT Environmental Section, (573) 526-4778, should be informed immediately to assure proper handling and compliance with environmental regulations. Also, neither MoDOT nor MoDOT's contractors shall discharge water contaminants into any waters of the state, which reduce the quality of these waters below the state's water quality standards. These water quality standards include the following (MO 10 CSR 20-7):

- (a) Waters shall be free from substances in sufficient amounts to cause the formation of putrescent, unsightly or harmful bottom deposits or prevent full maintenance of beneficial uses.
- (b) Waters shall be free from oil, scum and floating debris in sufficient amounts to be unsightly or prevent full maintenance of beneficial uses.
- (c) Waters shall be free from substances in sufficient amounts to cause unsightly color or turbidity, offensive odor or prevent full maintenance of beneficial uses.
- (d) Waters shall be free from substances or conditions in sufficient amounts to result in toxicity to human, animal or aquatic life.
- (e) Waters shall be free from physical, chemical or hydrologic changes that would impair the natural biological community.

(f) Waters shall be free from used tires, car bodies, appliances, demolition debris, used vehicles or equipment and solid waste as defined in Missouri's Solid Waste Law, Section 260.200, RSMo, except as the use of such materials is specifically permitted pursuant to Section 260.200–260.247.

MoDOT personnel or contractors hired by MoDOT shall comply with these and any other federal, state, and local laws and regulations controlling pollution of the environment. To ensure that these general criteria are met, the following guidelines will be observed:

- 1) Machinery shall be kept out of the waterway as much as possible.
- 2) Fuel, lubricants, debris and other water contaminants shall not be stored in areas that are subject to contact with water (such as adjacent to stream banks) or where contaminated runoff from the storage areas can enter waters.
- 3) Refueling and maintenance (e.g., oil changing) of machinery shall not take place in, or directly alongside, any water body.
- 4) Clearing of vegetation/trees shall be kept to the minimum required to accomplish the activity.
- 5) Riparian areas and banks shall be restored to a stable condition through recontouring and revegetation of the area, as necessary, as soon as possible (normally within three working days of final contouring).
- 6) Work shall be conducted during low flow whenever possible.
- 7) Wetland areas shall be avoided to the extent practical.
- 8) Work shall conform to all conditions that are part of the USACOE Section 404 permit and the ancillary MDNR Section 401 Water Quality Certification.

[EPG 127.19 Section 404 Clean Water Act for Bridge Demolitions](#) provides a detailed explanation of the process that is followed whenever a stream or drainage channel may fall into USACE jurisdiction.

#### **806.8.4–6 EROSION AND SEDIMENT CONTROL**

*(MO Specifications Division 800)*

Water pollution control measures shall be required of all contractors MoDOT hires. The contractor shall exercise best management practices throughout the project to control water pollution. Construction of permanent drainage facilities and other activities, which may contribute to the control of siltation, shall be accomplished at the earliest practicable time. This work shall [also](#) consist of furnishing, installing, maintaining, and removing temporary control measures as shown on the plans (see *MoDOT Standard Plan 806.10*) or as ~~ordered~~ [directed](#) by the engineer. The control of water pollution will be accomplished through the use of berms, slope drains, ditch checks, sediment basins, energy dissipaters, seeding and mulching, silt fences, and other erosion and sediment control devices or methods. Pollutants such as chemicals, fuels, lubricants, bitumens, raw sewage, or other

harmful materials shall not be discharged from the project. No work shall be started until the erosion and sediment control timetable and methods of operation have been approved.

Temporary control measures shall be coordinated with permanent control measures to assure economical, effective and continuous erosion and sediment control. Temporary erosion and sediment controls must be kept in place, inspected and maintained until revegetation, rock blanketing, paving, or another form of stabilization has occurred to an extent sufficient to minimize sediment loss from the project and comply with MoDOT's State Operating Permit.

Materials required for erosion and sediment control measures shall meet the standards of the *Missouri Standard Specifications for Highway Construction*.

### **806.8.46.1 Construction Requirements**

~~The goal for MoDOT land disturbance operations is to deliver the planned final product (e.g., roadway, bridge, etc.) while ensuring effective erosion, sediment and stormwater management throughout the design, construction and maintenance process to minimize sediment loss from the project. The engineer may limit the surface area of erodible earth material exposed by clearing and grubbing, or excavation, borrow, and fill operations, and may direct the contractor to provide immediate permanent or temporary erosion and/or sediment control measures to prevent contamination of adjacent streams or other watercourses, wetlands, lakes, ponds, and other water impoundments. Such work may involve the construction of temporary berms, dikes, dams, sediment basins, slope drains, and the use of temporary seeding and mulching, or other erosion and sediment control devices or methods as necessary.~~

~~The contractor shall be required to incorporate all p~~Permanent erosion control measures (e.g., permanent vegetation) shall be implemented into the project at the earliest practicable time in order to control erosion, reduce sediment control maintenance and improve the overall appearance of the project. Temporary erosion and sediment control measures shall be used to correct conditions that develop during construction which were not foreseen during the design stage. Temporary controls shall also be used when needed prior to installation of permanent erosion control measures or to control erosion that develops during normal construction practices, ~~but are not associated with permanent control measures on the project.~~

When practical, clearing and grubbing operations shall be scheduled and performed so that border, perimeter, or ~~outlet-outfall~~ BMPs to control runoff from disturbed areas will be installed or marked for preservation before general site clearing. A limited amount of clearing (enough to gain access to the area) may be permissible to enable the installation of ~~outlet-outfall~~ and perimeter controls. Stormwater discharges from disturbed areas, which leave the site, shall pass through an appropriate impediment (BMP) prior to leaving the site. The surface area of erodible earth material exposed at one time by clearing and grubbing, by excavating, by fill, or by borrow, shall be minimized to limit ~~vulnerability of erosion and potential sediment runoff~~ loss from the project. The engineer may limit the total acreage of erodible earth material to be exposed at one time as determined by an analysis of project conditions. In such cases the engineer will identify specific BMPs and controls that have been, or will be installed in order to exceed the specified maximum disturbed acreage threshold.

The engineer will limit the area of clearing and grubbing, excavation, borrow, and embankment operations in progress commensurate with the contractor's ability to keep the finish grading, mulching, seeding, and other erosion control measures current. Should seasonal limitations make such coordination unrealistic, temporary erosion and sediment control measures shall be implemented as directed by the engineer.

Unless otherwise approved, construction operations in rivers, streams, wetlands, and impoundments shall be restricted to those areas which must be entered for the construction of temporary or permanent structures. Rivers, streams, wetlands, and impoundments shall be promptly cleared of all falsework, piling, debris or other obstructions placed therein or caused by the construction operations.

Frequent fording of live streams or wetlands with construction equipment is not permitted.

Temporary bridges or other structures shall be used wherever ~~an appreciable number of~~ stream crossings are necessary. All temporary fills and structures placed in streams, wetlands, or impoundments will be removed and the site returned to natural or intended contours prior to completion of construction. Unless otherwise approved, mechanized equipment shall not be operated in live streams except as may be required to construct channel changes and temporary or permanent structures. If a Section 404 permit is applicable for a project, its requirements and/or conditions shall be followed.

Site-specific ~~erosion and sediment controls~~BMPs above and beyond those identified within the contract plans or MoDOT standard specifications shall be discussed with the contractor at a preconstruction conference, if known, or as necessary to control erosion and minimize sediment loss throughout the life of the project. The use of alternate BMPs or methods may be acceptable, but approval of alternate practices will need to be approved by the engineer. Also, ~~S~~special conditions may be developed which can include limitations on the amount of surface area that can remain unprotected at one time or could include special water quality or stream protections requirements.

The location of all local material pits (other than commercially operated sources) and all excess material areas shall be subject to the approval of the engineer (*material in this case refers to soil and rock*). Construction operations shall be conducted and pollution control measures implemented so that erosion will not result in water pollution.

Portable concrete and asphalt plants located on MoDOT right of way can be covered under the MoDOT State Operating Permit. Any discharges from these operations must be managed by appropriate BMPs. The plant and BMPs must be depicted on the project site map and appropriately accounted for in the project SWPPP. Operators of portable plants that are located off of MoDOT right of way will be responsible for obtaining all appropriate permits directly from the DNR. The contractor is responsible for all costs associated with erosion and sediment control to protect plant locations, regardless if the plant is located on or off of MoDOT right of way or easements.

Borrow and excess (waste) disposal sites located on MoDOT right of way or owned by MoDOT can be covered by the MoDOT permit and SWPPP. For borrow and excess disposal activities not located on MoDOT right of way, the borrow or excess disposal operator will be responsible for obtaining all appropriate permits, including a land disturbance permit directly from the DNR for sites greater than or equal to one acre.

In the event of a conflict between these requirements and pollution control laws, rules, or regulations of other federal, state, or local agencies, the more restrictive laws, rules, or regulations may apply.

#### **806.8.46.2 Non-Structural Control Measures**

Protection of existing vegetation is an important and sometimes overlooked component of erosion and sediment control. Preserving natural vegetation in certain areas during construction serves to slow the flow of water, protect against erosion and reduce sediment transport from sheet flow.



Vegetated filter strips (i.e., buffers) located along the shoulder, within the median, in MoDOT ditches, or adjacent to a body of water or wetland, serve as excellent sediment capture devices. They can be particularly effective in areas where the density of grass and other herbaceous vegetation can filter the water. In most cases, vegetative buffers are used in concert with other BMPs; however, there may be situations where vegetative filter strips can suffice as independent features. Depending on site characteristics, these areas of undisturbed right-of-way can potentially provide the same benefit to water quality as would many types of structural controls, such as silt fences, ditch checks, and sediment traps or basins. If natural or created vegetated filter strips are used, they must be located within MoDOT right of way or easement and inspected and maintained like other BMPs. Vegetation on an adjacent property cannot be used as a MoDOT BMP. During project design, site conditions and stormwater runoff analysis will determine the selection of appropriate BMPs, which may include non-structural BMPs and vegetated buffers. If during inspections, BMPs, including vegetated buffers, are determined to be ineffective or insufficient at controlling erosion or sediment transport, additional BMPs will need to be installed to effectively manage the stormwater runoff.

Preserving natural vegetative filter strips is especially important when working in proximity to surface waters, which may include, but are not limited to, rivers, streams, lakes, ponds and wetlands. When working along or adjacent to these features, MoDOT is required by its statewide land disturbance permit with MDNR to retain a minimum of a 25-foot buffer of undisturbed natural vegetation between land disturbance operations and the body of water, unless site conditions and/or limitations make the use of such a buffer infeasible. To comply with this permit requirement, when working adjacent to these waters, MoDOT should determine on a case by case basis whether preserving an existing buffer is feasible, or whether contractor or maintenance operations will require complete use of the area to facilitate work activities. Preserving natural vegetative buffers must be considered for all MoDOT projects working in proximity to surface waters; however, factors like limited right-of-way, contractor/maintenance access, and the nature of work activity (e.g., bridge and culvert installation, maintenance and repairs) are often going to make MoDOT's use of this BMP infeasible. In these cases contractor/maintenance activities would make use of most or all areas of right-of-way or easement, which could include work up to the edge of, or even within waters of the state. If a vegetative buffer can be preserved, it must be incorporated as a non-structural BMP and denoted on plan sheets to remain undisturbed. If use of a buffer is determined to be infeasible or not effective at managing stormwater runoff, as previously mentioned, MoDOT will install other appropriate alternative BMPs to minimize sediment loss from the project. The choice of an alternative BMP, or combination of BMPs, will depend on site variables, but could include the use of Type C Berms, sediment basins, sediment traps, ditch checks, perimeter silt fence (including mulch berms) and the effective use of temporary or permanent seed and mulch or erosion control blankets, all described within this SWPPP, to limit erosion and any subsequent sediment transport. All BMPs, including any vegetated filter strip(s), will need to be identified, inspected and managed within the project SWPPP.

Like other BMPs, vegetated buffers should be inspected for effectiveness and maintained accordingly. Sediment deposits within vegetated buffers may be left in place or removed post construction depending on MoDOT's future plans for the area and consideration of whether there is a potential to affect water quality in adjacent surface waters. Inspectors should also consider whether it would be more destructive to the buffer to retrieve sediment deposits than to leave them. If leaving sediment deposits within vegetated buffers, it may sometimes be necessary to seed and mulch over the area, depending on the amount of sediment deposited.

Other Non-Structural BMPs such as seeding, mulching, stabilized construction entrances, flocculants and other chemical additives are discussed elsewhere in this document.

~~Protection of existing vegetation is an important and too often overlooked component of erosion and sediment control. Prior to commencement of grading, design plans will show areas that are to remain undisturbed. Maintaining natural vegetation in certain areas during construction serves to reduce sediment from sheet flow, and slow the flow of water that travels through the area. These areas of excess right of way provide the same benefit to water quality as would many types of structural controls such as silt fences, sediment basins or sediment traps. Deposited material may or may not be removed from the area of excess right of way depending on MoDOT's future plans for the area.~~

~~Vegetated filter strips along the shoulder, or within the median of MoDOT highways serve as excellent sediment capture devices particularly in areas where the density of grass and other herbaceous vegetation can filter the water. In most cases vegetative filter strips (permanent vegetative cover) are used in concert with other BMPs (such as silt fence). However, there may be situations where vegetative filter strips can suffice as standalone features. If vegetated filter strips are used, they must be located within MoDOT right of way or easement. Vegetation on an adjacent property cannot be used as a MoDOT BMP.~~

~~Other Non-Structural BMPs such as seeding, mulching, stabilized construction entrances, flocculants and other chemical additives are discussed elsewhere in this document.~~

### **806.8.46.3 Erosion Control Measures**

~~*(MO Specifications—Special Provisions)*~~

~~Our~~ The emphasis on MoDOT projects should be erosion control ~~and~~, focusing on covering up exposed soil, preferably with permanent vegetation, rock, pavement, etc., as soon as practical in order to protect the soil surface and keep soil particles from dislodging and entering stormwater.

Focusing on controlling stormwater velocity and volume is also an important consideration. Best management practices (BMPs) shall be used by contractors to minimize sediment loss from MoDOT right of way onto adjacent land or into streams, lakes, ponds, wetlands, drainage channels, etc.

The following described practices are commonly used erosion control BMPs that may be used individually or in combination with other practices, such as the sediment control devices discussed in EPG 806.8.4.4 Sediment Control Measures, to assure effective erosion control and ~~prevent-minimize~~ off site delivery of pollutants. Other practices that are not listed here, or have not been identified or invented at the time of the preparation of this SWPPP, may be used if their performance is equivalent or better than the practices listed below.

#### **806.8.46.3.1 Soil Surface Roughening**

Surface roughening is a temporary erosion control BMP that will reduce runoff velocity and erosion potential by increasing infiltration and sediment trapping. This practice is intended for areas which have been cleared and grubbed and are awaiting application of temporary or permanent seed, or installation of other structural controls such as ditch checks, sediment traps, or sediment basins. The practice is NOT intended to serve as a stand-alone best management practice and is only to be used as a short-term, sequential practice as the grading and seeding proceeds.

Where backslopes are unlikely to be mowed or maintained due to steepness and lack of access, surface roughening can be a permanent measure. In these situations seed and mulch may be applied directly to the roughened seed bed. This will aid in the establishment of vegetative cover and will minimize destructive compaction by heavy equipment. There are three common methods of surface roughening (tracking, grooving, stair stepping) that can be employed depending on the soil type, slope and potential maintenance concerns for the project.

- A. **Tracking** involves the use of tracked construction equipment (dozer, high lift, etc.) vertically tracking up and down slopes in order to create horizontal depressions, perpendicular to the runoff path, on the soil surface. These depressions reduce stormwater velocity and the potential for concentrated runoff, which typically leads to rill formation. Tracking can lead to significant soil compaction, which does help lock soil particles in place; however, it is also undesirable for root production and grass growth. Due to this fact, care should be taken in deciding which slopes to track. Tracking is typically recommended for sandy soils, where risk of excessive compaction is reduced.
- B. **Grooving** involves the creation of a series of ridges and depressions that run along the contour of a slope. The grooves can be created using a variety of implements such as a disks, harrows, chisel plows, loader teeth, etc. The grooves should be no more than 3 inches deep and no more than 15 inches apart.
- C. **Stair-stepping** involves creating stair steps to reduce runoff velocity and encourage sedimentation on steeper slopes that will not be mowed. The stairs should be cut such that the vertical step does not exceed 1 foot. The horizontal step should be longer than the vertical step and sloped inward toward the vertical step face to promote sedimentation.

#### 806.8.46.3.2 *Mulching and Crimping*

Application of mulch without seed may be used as a temporary best management practice if approved by the engineer. This temporary stabilization practice is most applicable in late fall or early winter when grass seed would have little or no opportunity to germinate. Straw mulch should be applied with a mulch blower, or by hand, and must be anchored (crimped or otherwise tackified) immediately after spreading to prevent windblow. Application rates will vary based on the percent slope. Bark mulch and/or wood chips do not require crimping. The engineer will determine whether or not the wood chip mulch may remain in place, be cultivated or be modified for permanent seeding.

#### 806.8.46.3.3 *Temporary Berms — Erosion Control*

A temporary berm is a temporary ridge of compacted soil, with or without a shallow ditch, constructed at the top of ~~fill~~ slopes or transverse to centerline on fills. The purpose of these ridges is to divert storm runoff from small areas away from steep slopes and direct this water to temporary, stabilized outlets where the water can be discharged with minimum slope erosion. These ridges are used temporarily at the top of newly constructed slopes to prevent excessive erosion of the slopes until permanent controls are installed and/or the slopes are stabilized. They are also used transverse to grade to divert runoff to stabilized slope drains. Weekly (and post-~~rainfall~~runoff) monitoring inspections will be necessary to identify breaches in all temporary berms used as BMPs.

~~Type A Berms for erosion control may be specified for use at the end of each day's operations on embankments to divert stormwater away from project slopes and toward stabilized drop-down structures/pipes or stormwater detention areas, sediment capture devices, etc. They will be constructed to specified dimensions (see MoDOT Standard Plan 806.10) and machine compacted with a minimum of one pass over the entire width of the berm with a dozer tread, grader wheel, etc. Type A Berms can be used until grading operations cease and final contours are achieved. Removal will usually occur just before the application of seed and mulch or other soil stabilization measures.~~

**Type B Berms** are constructed on the top of ~~fill~~ slopes and are intended to direct runoff water ~~to divert stormwater away from project slopes and toward stabilized drop down structures/pipes or stormwater detention areas, sediment capture devices, etc.~~ They will be constructed to specified dimensions (see *MoDOT Standard Plan 806.10*) and machine compacted with a minimum of ~~one~~ three passes over the entire width of the berm with a dozer tread, grader wheel, etc. ~~into a temporary slope drain.~~ These temporary diversion structures are specified when embankment operations are shut down over extended periods of time ~~(i.e., winter), and will be constructed to specified dimensions (see *MoDOT Standard Plan 806.10*).~~ The top width of these berms may be wider and the side slopes flatter on transverse berms to allow equipment to pass over these berms with minimal disruption. Operation and maintenance concerns are limited to ensuring that the majority of runoff water is directed into the inlet of the slope drain. Removal of Type B Berms will normally occur when base rock is installed, prior to paving, but may be used longer if necessary.

#### **806.8.46.3.4 Temporary Pipe Slope Drains**

A temporary pipe slope drain (see *MoDOT Standard Plan 806.10*) is used to carry water down slopes to reduce erosion and may consist of half-round pipe, metal pipe, plastic pipe, or flexible rubber pipe. Temporary slope drains are usually required on fill and some cut slopes at approximately 500-foot intervals or as directed by the engineer. These structures are installed after the ~~fill~~ slope has reached its intended elevation and final grade.

All temporary slope drains will be adequately anchored to the slope to prevent disruption by the force of the water flowing in these drains. The inlet end will be properly constructed to channel water into the temporary drain. The outlet ends will usually have some means of dissipating the energy of the water to reduce erosion downstream and will have a sediment control BMP or a system of sediment control BMPs to capture sediment carried within the stormwater. Where scour at the outlet is of lesser concern due to the physical characteristics of the ditch, there shall still be sediment capture devices in the ditch or drainage outlet downgrade from the slope drain outlet. Unless otherwise specified, all temporary slope drains will be removed when no longer necessary due to the slopes being stabilized or the routing of runoff down permanent letdown structures. Upon removal of temporary slope drains, the site will be restored to match the surroundings.

### **806.8.46.3.5 Interception Ditches & Letdown Structures (Including Roadside & Median Ditches)**

Interception ditches and letdown structures are typically permanent erosion control BMPs that capture stormwater run-on or runoff and transport it down slopes through stabilized channels. [These constructed channels are meant to reduce the likelihood of gully formation and allow for the establishment of permanent vegetative cover on the face of the slope.](#) [Interception ditches and letdown structures](#) ~~These channels~~ are typically constructed in a “V”, “U”, or trapezoidal shape to concentrate water flow down the center of the structure in order to minimize the risk of break over points and flanking. They are typically lined with stone (riprap), erosion control blankets, turf reinforcement mats, or other product which is self-adjusting and capable of withstanding concentrated, erosive flows. In some instances, these ditches and letdowns may be constructed as concrete or asphalt gutters; however, these types of rigid channel liners do not allow for water infiltration and more often than not, do not have built-in energy dissipation, which can exacerbate erosion at their outlets. In addition, due to their rigid nature, concrete and asphalt-lined drainage courses often undermine and experience section loss, which leads to system failure. There are alternative BMP technologies available (e.g., [ShoreMax™](#), [ScourStop™](#), [Flexamat™](#), etc.) that give a degree of rigidity, if desired, to help armor the channel, or a portion of the channel more susceptible to erosion, while still allowing permeability for vegetative growth and water infiltration, as well as self-adjustment to prevent system failure.

When designing and implementing interception ditches and letdowns, as well as roadside and median ditches, it is important to take into consideration drainage area, soil type, slope and ditch shape in order to determine if the shear stresses within the ditch will be of a high enough value to warrant a liner beyond just vegetative cover. Depending on the location of the ditch, driver safety must also be taken into consideration when choosing an appropriate ditch liner.

[Refer to 806.8.4.2 Non-Structural Control Measures for the benefits of existing or reestablished vegetation within ditches, swales and other areas of right of way.](#)

### **806.8.46.3.6 Temporary Pipes & Temporary Construction Crossings**

A temporary pipe is a conduit used temporarily to carry water under a haul road, silt fence, etc. Temporary pipes should be installed in the same manner as permanent pipe is installed on the project to assure that the water does not cause erosion around the pipe. If applicable, material to backfill the pipe should be placed in six-inch lifts and mechanically compacted, although a compaction test is not required. As additional erosion protection, temporary pipes can also be used to collect site run-on and convey it across disturbed areas on the job. Care should be taken to ensure the outlet of the temporary pipe is stabilized and adequate energy dissipation is available so as to not cause erosion of the receiving area.

Temporary pipes can also be used to convey normal and expected high flows at temporary stream crossings, preventing the contractor's equipment from coming into direct contact with the water when crossing active streams as discussed in [EPG 806.8.4.1](#) (Construction Requirements). Any temporary structures used to facilitate construction (e.g. temporary crossings, temporary work pads) will be constructed of clean rock fill that is of sufficient size to be non-erodible under normal stream flow and also easily recoverable upon project completion. Temporary stream crossings will be sufficiently piped to allow for continuous and relatively unimpounded stream flow. The pipes will be placed to match the existing stream grade, which will allow for unimpeded aquatic life passage through the project area. Upon project completion, any temporary structure(s), including pipes and other materials, shall be completely removed and the area will be restored and stabilized.

*-(Note: Temporary stream crossings can act as conduits for sediment to make its way to streams, because they usually cause a gap in perimeter BMPs along streambanks. If possible, stormwater runoff should be diverted away from these structures; otherwise other BMPs must be employed to adequately protect the waterbody.)*

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### 806.8.46.3.7 Energy Dissipaters

An energy dissipater is a physical structure that is intended to reduce the erosive energy that is typically encountered down grade from a pipe or culvert. As such, these BMPs are normally permanent. Erosive energy from intense flows may also be encountered in median ditches or road ditches. Energy dissipation may be accomplished by the installation of large boulders, wood pilings, engineered concrete structures or other means approved by the engineer, following construction of the ultimate drainage channel or device. Unlike ditch checks and sediment traps, energy dissipaters are NOT intended to impound water and sediment. Energy dissipaters must be constructed in a fashion such that the water that flows through, over or around the structure is equally distributed in the discharge channel and does not exacerbate or cause a resultant erosion problem.

### 806.8.46.3.8.1 Temporary Seeding and Mulching (MO Specifications Sections 802 & 805)

This work shall consist of preparing and fertilizing a seedbed, furnishing and sowing of seed, and mulching. The purpose of temporary seeding and mulching is to produce a quick ground cover of annual grasses to reduce erosion in disturbed areas that are expected to be either re-disturbed or permanently seeded at a later date. It should be utilized-used as necessary to prevent erosion and decrease reliance on and potential costly maintenance of sediment control BMPs. For project planning purposes, it is important to understand that temporary vegetative cover will begin to lose its effectiveness within 6 to 12 months depending on site conditions.

Seeding and/or mulching will be a continuous operation on all cut and fill slopes, waste sites, and borrow areas during the construction process. ~~Designated, d~~Disturbed areas shall be seeded and mulched when and where necessary to eliminate erosion. In designated areas seeding and/or mulching shall be done as soon as possible after completion of the earthwork, not to exceed 14 days (7 days on slopes steeper than 3:1), weather permitting. Most disturbed areas, with the exception of the road grade itself, shall be seeded and mulched during the fall to establish vegetative cover prior to winter shutdown. If final grade has been achieved, this operation should consist of establishing permanent vegetation, not temporary.

Temporary mulch placed over temporary seed mixtures shall be applied in accordance with the provisions of Sec 802.2.1 of the *Missouri Standard Specifications*. Fertilizer shall be applied at the rate specified for permanent seeding. Lime will usually not be required for temporary seeding but will be applied according to governing specifications when a permanent seed mixture is used.

### 806.8.46.3.8.2 Permanent Seeding and Mulching (MO Specifications Sec 805)

Permanent seeding and mulching following the temporary seeding will be performed according to the *Missouri Standard Specifications Sec 805* and ~~will should typically~~ be permitted during ~~the~~ favorable seeding seasons only. It is important to remember that temporary seeding and mulching can be used to cover up bare soil during times that are not conducive to applying permanent seeding. Then, when conditions are more suitable for permanent seeding, it can be applied over/through the temporary seeding stubble. Or, in some cases, it may be necessary to mow the temporary seeding stubble and then apply permanent seeding.

Any revisions or deviations from contract seed mixtures and applications must be approved by MoDOT's Roadside Section within the Maintenance Division.

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**806.8.46.3.9 Fiber Reinforced Matrix (FRM)**

Fiber Reinforced Matrix (FRM) is a hydraulically applied (spray-on) erosion control product that bonds to, and blankets bare soil. It is typically applied with a truck or trailer mounted sprayer or by walking the affected areas with a hose sprayer. According to manufacturers, FRMs lock in moisture and nutrients to promote seed germination. Since these products are applied through spray-on application, they can conform to the contours of a slope and therefore can be applied to rough seedbeds. These products can be applied to all soil types on any slope and can be used in place of any of the erosion control blankets (ECBs) discussed in EPG [806.8.4.3.10](#) below. However, these products are only to be used as slope protection, and are not designed to withstand concentrated flows within ditches, drainages or streams. It is important when using these products to apply them according manufacturer’s specifications and to assure there is complete surface coverage on the affected area to prevent potential failure due to improper application. In order to accomplish this it is important to spray slopes from multiple, varying directions. In some instances, especially on longer and/or steeper slopes, it may be necessary to install slope disruptors (wattles/socks/logs/etc.) perpendicular to the sheet flow to decrease runoff velocities down the face of the slope and protect the FRM application from concentrated flows. Manufacturer recommended application rates are summarized in the table below. Examples of FRMs include products such as Flexterra® Flexible Growth Medium™, EcoFlex™ and Flex Guard®.

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Slope Condition	Application Rate (lbs/Acre)
≤ 3H:1V	3000
> 3H:1V and ≤ 2H:1V	3500
>2H:1V and ≤ 1H:1V	4000
>1H:1V	4500

To ensure product quality and performance, all FRMs must meet the following specifications:

Table 1: Minimum FRM Performance and Physical Requirements Property		Required Value
Thermally Processed Fiber by Weight		75% ± 10%
100% bio-degradable Interlocking Fibers		5% ± 2%
Organic Tackifiers and Activators		10% ± 2%
Moisture Content		10% ± 3%
Organic Matter		90% minimum
Color		Colored to contrast application area, shall not stain concrete or painted surfaces.
FRM Property	Test Method	Required Value
<b>Physical</b>		
Mass Per Unit Area	ASTM D6566*	12.0 oz/yd <sup>2</sup> minimum
Thickness	ASTM D6525*	0.22 inch minimum
Ground Cover	ASTM D6567*	99% minimum
Wet Bond Strength	ASTM D6818*	9 lb/ft
Water Holding Capacity	ASTM D7367	1500 % minimum
Flexural Rigidity (wet)	ASTM D6575*	5 oz-yd maximum
<b>Endurance</b>		
Functional Longevity	ASTM D5338	Minimum of 12 months
<b>Performance</b>		
Cover Factor	MoDOT Approved Large Scale Testing	0.01 maximum
% Effectiveness	MoDOT Approved Large Scale Testing	99% minimum
Cure time	MoDOT Approved Large Scale Testing	98% Effective 2 hours after application
Vegetation Establishment	ASTM D7322*	800% minimum
<b>Environmental</b>		
Ecotoxicity	EPA 2021.0	96-hr LC50 > 100%
Effluent Turbidity	MoDOT Approved Large Scale Testing**	100 NTU Maximum



Biodegradability	ASTM D5338	100% Minimum
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### 806.8.46.3.10 Erosion Control Blankets & Turf Reinforcement Mats

Erosion control blankets (ECBs) and turf reinforcement mats (TRMs) are designed to [protect and reinforce vegetation from erosive forces until it can become established, or in the case of TRMs, in perpetuity. ECBs and TRMs are typically manufactured with straw, wood fiber \(excelsior\), jute, coconut coir fiber and synthetic materials or combinations of these materials. The added reinforcement allows the vegetation to withstand higher flow velocities and can be an alternative to rip rap applications.](#)

ECBs are typically used to prevent sheet, rill, or gully erosion on slopes and some lower flow channels. TRMs may be used on [steep slopes or](#) slope areas with concentrated flow, but are typically used in channels. Since ECBs have a limited life expectancy (longevity) they are considered to be "temporary" erosion control measures; however, most TRMs are composed of interwoven layers of geosynthetic materials such as polypropylene, nylon and PVC netting, which protects from both bio and photodegradation and allows for permanent vegetative reinforcement. At culvert outlets, overflow structures or transition areas, it may be necessary to use a transition mat (e.g., ScourStop™, ShoreMax™, etc.) directly over the TRM in order to add additional scour protection in these highly erosive areas.

Slopes should be stabilized as soon as possible after grading work is completed. ~~ECBs, or TRMs, or~~ [an equivalent erosion control practice should be considered is recommended for most slopes steeper than 3:1, depending on soil types.](#) Protecting slopes from erosion requires several actions that must be taken together. No single approach will be successful, especially if the slope is long, steep, or has highly erodible soils. [Even when using blankets or mats, it may be necessary to incorporate temporary berms and slope drains, slope disruptors and other BMPs to ensure slope stabilization.](#)

[All ECBs and TRMs shall be installed according to the manufacturer's recommendations, including overlap and stapling guidelines. Mats and blankets will be installed as soon as practicable after final grading. Removal is not necessary or required seeing as how the material will decay and break down on its own or, in the case of TRMs, permanently reinforce the vegetation.](#)

Prior to installation of blankets or mats the ground should be smooth, with no large rocks, vegetation or rills on the surface. Areas where blankets are to be used shall be properly prepared with topsoil or soil conditioning, ~~and~~ fertilized (if required), and seeded before blankets are placed. The blankets shall be placed smoothly, but loosely, on the soil surface without stretching. Blankets at the top of the slope should be trenched in beyond the crest of the slope ~~so as~~ to avoid undercutting. [Any overlap joints shall be lapped in the direction of water flow.](#)

Blankets and mats should be inspected at the same frequency as all other erosion and sediment control items. Malfunctions must be repaired in a timely manner or else slope shaping, grading and reinstallation will be required. [Removal is not necessary or required because the material will decay and break down on its own or, in the case of TRMs, permanently reinforce the vegetation.](#)

[Product requirements for ECBs and TRMs can be found within MO Specifications Section 1011. Products meeting the requirements outlined within the tables below ECBs and TRMs meeting MoDOT specification requirements](#) each have their own physical description that can be obtained from the manufacturer. Providing the physical description of all ECBs or TRMs would be unnecessary and redundant for the purposes of ~~this the~~ SWPPP.

### Guidelines for Erosion Control Blankets (ECBs)

MoDOT ECB Type	Netting	Longevity	Slopes	Soils
Type 1	Single Net, Quickly Degradable	45—60 Days	3:1 or Flatter	Clay
Type 2	Single Photodegradable Net	12 Months	3:1 or Flatter	Sandy
Type 3	Double Photodegradable Net	12—18 Months	2:1 or Flatter	Clay
Type 4	Double Photodegradable Net	24 Months	2:1 or Flatter	Sandy
Type 5	Double Photodegradable Net	36 Months	1:1 or Flatter	Any

### Guidelines for Turf Reinforcement Mats (TRMs)

#### Type 1 Turf Reinforcement Mat

• Channels: Calculated Shear Stresses of 3.5 lbs/ft<sup>2</sup> to 6 lbs/ft<sup>2</sup>

#### Type 2 Turf Reinforcement Mat

• Channels: Calculated Shear Stresses of 6.1 lbs/ft<sup>2</sup> to 8 lbs/ft<sup>2</sup>

#### Type 3 Turf Reinforcement Mat

• Channels: Calculated Shear Stresses of 8.1 lbs/ft<sup>2</sup> to 10 lbs/ft<sup>2</sup>

#### Type 4 Turf Reinforcement Mat

• Channels: Calculated Shear Stresses of 10.1 lbs/ft<sup>2</sup> to 14 lbs/ft<sup>2</sup>

*(Note: Use Erosion Control Blanket for Calculated Shear Stresses up to 3.5 lbs/ft<sup>2</sup> and use Turf Reinforcement Mat for Calculated Shear Stresses of 3.5 lbs/ft<sup>2</sup> or greater.)*

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Comment [NDM1]: I believe Dennis wanted this pulled from the SWPPP as it will now be in Section 1011 of the spec book, which needs to be changed from "Geotextile" to include ECBs and TRMs

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### 806.8.46.4 Sediment Control Measures

As previously stated, ~~our~~ the emphasis on MoDOT projects should be erosion control, and focusing on covering up exposed soil, preferably with permanent vegetation, rock, pavement, etc., as soon as practicable in order to protect the soil surface and keep soil particles from dislodging and entering stormwater. While erosion control should be the primary focus, it is important ~~that we to~~ back up ~~our~~ erosion control efforts with appropriate and effective sediment control. Sediment control is most effective when ~~we incorporate~~ incorporating a system of structural BMPs (treatment train) and ~~we~~ focusing our efforts on combatting sediment as close to its source as possible.

Understanding soil types is important when designing and implementing sediment control BMPs. Sand and silt consist of larger particle sizes that will fall out of suspension in stormwater more readily than clays. Clay particles are very fine and tend to stay in suspension for significant periods of time. Traditional sediment control BMPs, such as silt fence and ditch checks, are most effective at removing sand and silt from suspension. Larger impounding BMPs, such as sediment basins and sediment traps, are also effective at removing sand and silt, but can be effective at removing clay, due to prolonged impoundment. Even these impoundments may not successfully remove clay particles from suspension. In these situations, it may be necessary to include flocculants within a BMP system to remove excessive clay from stormwater prior to discharge from the project site. Flocculants are discussed in more detail in EPG 806.8.13 Turbidity Reduction and Advanced Treatment Systems.

The following sediment control measures should be used in combination with erosion control practices to treat stormwater and minimize sediment loss from MoDOT projects.

#### 806.8.46.4.1 Sediment Basin

A sediment basin is a large sediment capturing device that can be constructed through excavation, or by constructing a dam across a low drainage swale to trap and store water and sediment that may not be caught by upgrade erosion and sediment control measures. Sediment basins can be temporary or permanent. Both permanent and temporary basins, ~~with expected prolonged use,~~ should be constructed with defined side slopes and rock riprap placed in inlet and outlet areas. with rock riprap placed in inlet and outlet areas with defined side slopes (see *MoDOT Standard Plan 806.10*). ~~Temporary s~~ Sediment basins ~~intended for short term use do not have to be constructed according to the MoDOT standard plan, but will~~ shall always have stabilized outlets designed to discharge water from the surface of the basin. The stabilized outlets typically consisting of one, or a combination of the following: rock, a riser pipe, or a surface skimmer (e.g., Faircloth Skimmer®), ~~all designed to discharge water from the surface of the basin. Sediment basins are constructed to trap and store~~

~~sediment from erodible areas in order to protect properties and stream channels below the installation from excessive siltation.—As a general rule, basins should be designed and constructed twice (minimum) as long as wide in order to maximize time of concentration within the structure.~~ To add additional sediment removal capability to basins, baffles can be designed within the basin to slow stormwater flow and increase treatment time within the basin. Basically, the longer the water takes to get from the inlet of the basin to its outlet, the more effective the treatment and the better the water quality at the outfall.

Sediment basins are required (unless infeasible due to site constraints) when large disturbed areas ( $\geq 10$  acres) concentrate flow to one discharge point, but they should be considered for any disturbed area, 5 acres or greater, which drains to one discharge point. ~~The area where a sediment basin is to be constructed shall be cleared of vegetation to enable removal of sediment.—~~The inlets of these sediment basins shall be constructed with a wide cross-section and minimum grade to prevent turbulence and allow deposition of the soil particles. Upon construction of the basin, the side slopes of the basin should be seeded down with either annual or perennial vegetation or otherwise stabilized to protect the slopes from erosion. ~~When the depth of sediment reaches 1/2 of the depth of the structure in any part of the pool, all accumulation shall be removed.—~~Discharges from the basin shall not cause scouring of the receiving area or stream.

The location of sediment basins will be shown on the plans. Sediment basins should be designed to a sufficient size to contain a volume of at least a 2-year, 24-hour storm for the area draining to the basin, or, if this calculation has not been performed, then a basin should be designed to contain a volume of 3,600 cubic feet per each acre of disturbed area which drains to the basin. Where the use of a sediment basin of sufficient size as described above is impractical it should be documented in the SWPPP and ~~other similarly effective BMPs~~ ~~or system of BMPs~~ must be employed to minimize sediment loss from MoDOT right of way. These similarly effective BMPs or BMP systems could include, but are not limited to sediment traps, ditch checks, type C berms, etc., and the use of appropriate erosion control items to cover up exposed soil. An explanation for selecting these similarly effective BMPs instead of a basin ~~should will~~ be documented in the project SWPPP.

Sediment basins should be installed at the time of clearing and grubbing, and will normally remain in service until all disturbed areas draining into the structure have been satisfactorily stabilized. Once vegetative or other stabilization is achieved, the engineer will determine whether ~~the a~~ sediment basin is to remain as a permanent feature. If a sediment basin is to be permanent, its slopes shall be stabilized with rock riprap or equivalent (see MoDOT Standard Plan 806.10). ~~When-If~~ use of ~~the a~~ sediment basins is to be discontinued, all excavations are to be backfilled and properly compacted, fill material removed, and the existing ground restored to its natural or intended condition.

Accumulated sediment shall be removed from the basin when the basin is no more than half full. ~~When a~~ accumulated sediment ~~is~~ removed from ~~individual BMPs~~ sediment basins, ~~the excavated material~~ shall be disposed of in locations where ~~it~~ sediment will not ~~again~~ erode into ~~the~~ construction areas or ~~into natural waterways~~ waters of the state.

#### **806.8.46.4.2 Sediment Trap**

A sediment trap is a temporary sediment collection structure that is used for sediment control purposes. If properly maintained, the life expectancy of these structures can be approximately 2 years. Sediment traps will be in place prior to clearing and grubbing operations and shall remain in place until adequate stabilization to prevent erosion (vegetative cover, rock, concrete, etc.) is established upgrade of the structures. ~~When practical, sediment traps should be installed prior to land disturbance activities.—~~In situations where long-term maintenance issues are absent, and permanent

vegetation has established, sediment traps may be left in place as a permanent structure as long as there is no threat to the natural or human environment.

Sediment traps may be constructed of rock (as per the MoDOT Standard Plans) or other non-erodible material sufficient to temporarily impound water, or may be a simple excavated pit. The length and height of the sediment trap depends on the volume of water that flows through the drainage structure and the width of the drainage channel. Sediment traps may be placed downgrade of a drainage structure outlet to prevent sediment from leaving MoDOT right of way. When a ditch drains into a stream, the sediment trap will be placed at the drainage ditch outlet. Sediment traps are not appropriate where impounded sediment and gravel could accumulate inside of the culvert. They are usually placed down grade of a drainage structure or ditch outlet to prevent sediment from leaving MoDOT right of way. Sediment traps may also be constructed by placing a rigid, blocking structure (wood, steel, concrete) across the inlet or upstream opening of a pipe or culvert. This device can be referred to as a culvert block sediment trap (CBST). When using this device, heavy sediment particles will settle in front of the structure and clearer water will pass over the device and through the pipe.

Sediment traps are not typically appropriate in streams that are regulated by the US Army Corps of Engineers under Section 404 of the Clean Water Act. However, certain construction within the regulated channel may necessitate their use. The design of a sediment trap in this situation must be approved by the Design Division's Environmental and Historic Preservation section prior to inclusion in the plans.

~~Around larger, more permanent streams, sediment traps should be placed parallel to the stream at each ditch outlet. They will be in place prior to clearing and grubbing operations and shall remain in place until adequate stabilization to prevent erosion (vegetative cover, rock, concrete, etc.) is established upgrade of the structures.~~

Sediment traps may be dewatered through a single riser pipe, over a stabilized spillway (rock-lined, lined with erosion control blanket or turf reinforcement matting, vegetated), or, where applicable, allowed to filter through the interstices of a constructed rock barrier.

The location of sediment traps will be shown on the ~~inspector's~~ site plans. Accumulated sediment shall be removed from the trap when sediment has accumulated to 1/2 the height of the structure, or if an excavated pit, 1/2 of the original depth. Accumulated sediment removed from the sediment traps shall be disposed of in locations where sediment will not ~~again~~ erode into ~~the~~ construction areas or ~~into natural waterways~~ waters of the state. Discharges from the sediment trap shall not cause scouring of the receiving area or banks or bottom of the receiving stream.

~~Traditional R~~Rock sediment traps will be constructed in accordance with Standard Plan 806.10 and Standard Specification 806.60. Estimated quantities for each trap located on the project will be shown to the nearest cubic yard.

#### **806.8.46.4.3 Ditch Checks**

*(Ditch checks are also considered erosion control measures.)*

MoDOT has two categories of ditch checks – rock and alternate ditch checks. These erosion and sediment control structures are typically used when the road ditch has been "cut" or "rough cut" to its final or near final dimensions, before the application of seed and mulch; however, they may also be installed prior to achieving final ditch grade in order to prevent erosion and protect from sediment loss.

**Rock Ditch Checks** are the predominant ditch check to be used on MoDOT projects. Rock ditch checks can be specified in most drainage areas where ditch slopes are 10 percent or less, and where expected ditch flow volumes and velocities are high ([see MoDOT Standard Plan 806.10](#)). For scenarios that exceed the criteria established above, a combination of rock ditch checks and erosion control blankets (ECBs) or turf reinforcement mats (TRMs) should be ~~utilized~~used. (Note: *ECBs or TRMs may be designed into and ~~utilized~~used in any ditch or drainage regardless of the criteria outlined in this article.*)

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Rock ditch checks will typically be ~~composed~~constructed of rock with a predominant size between 4 and 12 inches, but this size may be adjusted to incorporate larger sizes if site conditions warrant. They will have a minimum effective height of 18 inches as measured in the field (see MoDOT Standard Plan 806.10). In areas of clay soils, where additional filtration may be needed, the upgrade face of the check can be capped with smaller stone, filter fabric or another approved filtering media. In some cases, it may also be necessary to place a section of ECB or geotextile beneath the rock ditch check and extending downgrade of the structure to prevent the rock from settling into the soil beneath and/or protect from downstream scour within the ditch line.

Experience and history have shown that well-constructed rock ditch checks can withstand more intense ditch flows than alternate ditch checks. For this reason rock ditch checks or sediment traps should be used at project points of concentrated discharge (i.e., outfalls). The last two ditch checks, in any ditch check system should be rock ditch checks or one rock ditch check followed by a sediment trap.  
~~As a general rule, the last ditch check in a system of ditch checks, prior to discharging from MoDOT right of way, should be a well-constructed rock ditch check or a sediment trap. These devices tend to withstand heavy flows and have a greater volume for impoundment.~~

**Alternate Ditch Checks** should be considered as an alternate to rock ditch checks in areas where there are safety concerns for the traveling public or other constraints where there would be concern with installing rock. These devices can typically be used in smaller drainage areas (generally 3 acres or less), with ditch slopes of 4 percent or less, and where expected ditch flow volumes and velocities are small (see [MoDOT Standard Plan 806.10](#)). These thresholds may be exceeded at the approval of the engineer. If the total number of alternate ditch checks needed on a project is minimal, it is advisable to just specify all ditch checks as rock for simplicity of contract administration.

Alternate ditch checks should have an effective height of at least 9 inches as measured in the field and should be installed in accordance with the manufacturer's recommendations or as outlined in this SWPPP.

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**Alternate Ditch Checks** can include the following or other engineer approved devices:

- Triangular Silt Dike®
- EnviroBerm® Porous Sediment Control System (In combo with ECB or TRM)
- GeoRidge/GeoRidge Biodegradable (Nilex) (In combo with ECB or TRM)
- Compost Filter Berms (1'(H) x 2'(W)) (Covered with biodegradable ECB/TRM)
- Sand Bags

Fiber Rolls, Sediment Logs, Compost Filter Socks – staked & ≥ 9” effective height and must be used in combination with ECBs or TRMs as a channel liner beneath, unless used in a ditch with sufficient existing vegetative cover to prevent erosion.

**(IMPORTANT: Straw wattles, straw bales and geotextile silt fence are no longer acceptable as a ditch check BMPs.)**

Each type of ditch check (particularly the tubular/cylindrical/triangular products) will have specific directions for installation. In all cases care shall be exercised so as to install the device according to manufacturer specifications. Effectiveness may be compromised if not installed correctly.

Ditch checks shall be placed and constructed according to the plans (see MoDOT Standard Plan 806.10)–, which shows the spacing for ditch checks. The estimate of the required number of ditch checks is based on an effective height of 9 or 18 inches. In some cases local conditions may dictate some deviation from the dimensions and shape that are shown in the Standard Plans; however, deviations from Standard Plans must still ensure that sediment capture and erosion control is occurring.

Ditch checks shall be checked for sediment accumulation after each runoff event. Sediment shall be removed when it reaches 1/2 of the original height, or before. Sediment removal will include removal and disposition in a location where it will not erode into construction areas or watereourseswaters of the state. Inspections shall be made to ensure that the center of the check is lower than the edges. This will ensure that water overflow will be directed into the middle of the roadway ditch. Erosion caused by high flows around the edges of the ditch check shall be identified in routine inspections and shall be corrected ~~so as~~ to protect backslopes and inslopes, as well as the effectiveness-integrity of the BMP.

Ditch checks shall remain in place until the engineer directs that they be removed once adequate stabilization (vegetative cover, rock, concrete, etc.) upgrade of the structures has been achieved in accordance with the permit. Upon removal, the contractor shall remove and dispose of any excess silt accumulations, grade and dress the area to the satisfaction of the engineer, and establish stabilization on all bare areas. As a general rule for rock ditch checks, once the area has reached final stabilization, any collected sediment should be removed and rock ditch checks can be graded out within the ditch line, serving a similar purpose as a liner. In rare cases, rock ditch checks may remain in place permanently, and resultant accumulated sediment shall be allowed to develop vegetative cover as a permanent feature of the right of way. Similarly, biodegradable structures and their accumulated sediment may be allowed to remain in place if the engineer determines that removal will destabilize the ditch. In cases of compost, mulch, etc. filled checks, the wooden stakes should be pulled and the biodegradable netting cut to encourage more rapid degradation. If the netting is non-biodegradable, the netting shall be cut and removed along with the stakes, but the biodegradable filling may be left to decompose.

**806.8.4.4 Silt Fence**  
(MO Specifications [Sections 624 & 1011](#))

Use of a silt fence consists of furnishing, installing, maintaining, and removing a geotextile barrier fence designed to remove suspended particles from water passing through the fence. Silt fence is a temporary sediment control measure [to control sheet flow along the edge of the right of way where runoff attempts to leave the project onto an adjacent property or into an adjacent body of water or wetland. Silt fence must never be used in concentrated flow to cross a ditch, stream or drainage channel, and in no case installed downgrade from a pipe or culvert. —Materials used for silt fences must meet certain requirements.](#)

There are several construction requirements for silt fences. [Where possible, silt fencing should be installed in existing vegetation, outside of, or at the edge of project clearing limits, so that a buffer of undisturbed soil and vegetation remains on both sides of the fence.](#) Fence construction shall be adequate to handle the stress from hydraulic and sediment loading. Geotextile at the bottom of the fence shall be ~~entrenched~~ [buried](#). The trench shall be backfilled and the soil compacted over the geotextile. ~~The~~ [When two sections of geotextile silt fence come together or if a new run must be started, the fence shall be spliced overlapped together](#) as indicated on the standard drawings (see *MoDOT Standard Plan 806.10*).

**Comment [NDM2]:** Do we show this on the new standard?

As a general rule, geotextile silt fence, especially non-wire reinforced geotextile silt fence, should not be used as inlet protection, particularly around culvert and ~~drop inlets~~ [drop inlets](#) where high volume, concentrated flows are expected, except in the instance described in [806.8.4.4.6 Inlet Controls](#). Geotextile silt fence is also not appropriate for use as ditch checks.

Post spacing shall not exceed 8 feet for wire-backed fence installations or 5 feet for self-supported installations. Posts shall be driven a minimum of 24 inches into the ground. Where rock is encountered, posts shall be installed in a manner approved by the engineer, or an ~~other~~ alternative BMP may be selected. Closer spacing, greater embedment depth and/or wider posts shall be used as necessary in low areas and soft or swampy ground to ensure adequate resistance to applied loads. In low swales, where concentrated flows may form, consider using a ditch check [or sediment trap](#) in lieu of silt fence. If heavy sediment or runoff loading is expected against the silt fence, the use of metal “T” posts should be considered in lieu of wooden post stakes.

When wire support fence is used, the support wire shall be fastened securely to the up-slope side of the post. The support wire shall extend into the trench a minimum of 2 inches and extend a maximum of 36 inches above the original ground surface. When self-supported fence is used, the geotextile shall be securely fastened to fence posts.

When silt fence is used as a perimeter sediment control device it will generally be installed at the time of clearing and grubbing, and must be maintained for as long as necessary to contain sediment from runoff. Silt fence should be installed on the contour when possible, [perpendicular to sheet flow](#), to prevent overtopping or overloading at single points. If ~~it~~ [silt fence](#) is run down a grade, ~~parallel~~ [not perpendicular](#) to ~~runoff sheet~~ flow, J-hooks should be installed into the silt fence system to dissipate energy and capture runoff so as ~~to~~ [not to undermine the fence or](#) overwhelm the system at a low point. [J-hooks should be installed toe to top, similar to ditch checks, with the tail of the downgrade J-hook terminating behind the leading edge of the previous \(see MoDOT Standard Plan 806.10\).](#) All silt fences shall be inspected as part of MODOT’s routine inspections. It is also recommended that casual daily inspections be made during periods of prolonged rainfall. [Common deficiencies to watch for during silt fence inspections include tearing, undermining, and collapsing.](#)

In addition, review of the location of silt fences should be made in areas where construction activities have changed the natural contour and drainage runoff to ensure that the silt fences are properly located for effectiveness. Where deficiencies exist, additional silt fences, or another appropriate BMP shall be installed as approved or directed by the engineer. If silt fence is no longer necessary in an area, it should be removed to negate maintenance and liability.

Sediment deposits shall be removed and disposed of when the deposit approaches 1/2 the height of the fence or sooner. If required by heavy sediment loading, a second silt fence shall be installed as directed by the engineer. Installation of a second silt fence will sometimes preclude sediment cleanout or repair to the original silt fence. In such cases the damaged silt fence will be removed at project close out when other temporary BMPs are removed.

The silt fence shall remain in place until areas that drain to the fencing are stabilized in accordance with the permit and the engineer directs that it be removed. Upon removal, the contractor shall remove and dispose of any excess silt accumulations, grade and dress the area to the satisfaction of the engineer, and establish vegetation on all bare areas. Biodegradable silt fence (such as some of the example products listed below) need not be removed [with approval from the engineer](#). If the engineer determines that silt fence shall remain in place for a period of time after the job is closed out, arrangements will be made by MoDOT Construction personnel for the contractor or MoDOT Maintenance personnel to remove the fence once the area is sufficiently stabilized in accordance with the permit.

At the discretion of the engineer the following [list of](#) product examples or other approved BMPs, [like mulch berms](#), may be substituted for perimeter geotextile silt fence. These devices should be installed in accordance with manufacturer recommendations. In the case of the wattles, socks and log devices, if practical and possible, a cradle trench should be created to lay the product in to ensure proper contact with the ground surface. This may not be appropriate if installing these devices in areas with existing grass cover, such as yards, or in areas with shallow utilities or bedrock beneath; [however regardless](#), care should be taken to ensure flush contact with the ground surface. Thought should also be put into product choice based on expected longevity, as some devices listed below will decompose or break down more quickly than others, and may require replacement or multiple replacements during the life of a job. In general, perimeter silt fence installations should have a minimum ~~of~~ 9" in effective height, [as measured in the field](#), unless site conditions warrant a higher or lower effective height.

Example products:

- Sediment STOP
- Terra-Tubes
- Sediment Logs, Wattles
- Compost Filter Socks/Berms
- Triangular Silt Dike

**806.8.46.4.5 Rock/Mesh Sediment Control Fence and Inlet Protection Device**

In situations when higher velocity stormwater flows are expected around the perimeter of a construction site, a rock/mesh sediment control fence should be installed in lieu of geotextile or other silt fence applications. This device is constructed using a 4 ft. wire mesh (hardware cloth – 24 gauge, ¼ in. openings) folded in half to form a 90° angle. This mesh is then wired to, and supported by 5 ft. metal “T” posts spaced 3 ft. apart and driven approximately 2 ft. into the ground. Lastly, a layer of

~~#5 or #57~~ grade 4 or grade 5 aggregate for drainage (Missouri Standard Specifications Sec 1009)  
~~stone~~ is placed against the mesh, with a minimum height of 12 in., but preferably 18 in. (see MoDOT Standard Plan 806.10)

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Use this device in lieu of other silt fence applications at the toe of fill sections, especially along streams and wetlands and in other areas where there is insufficient right of way to construct better impoundment devices, such as sediment basins or sediment traps. As with silt fence applications, the sediment control fence should be placed perpendicular to stormwater flow, allowing the water to pass either over or through the rock/mesh sediment control fence, never around it.

This same device can be modified for use around drop inlets, creating a closed ring or box around the inlet opening using the same installation guidelines outlined above.

Rock/mesh sediment control fences shall be inspected during weekly and post-runoff inspections for structural damage, undercutting, sediment buildup, or lack of drainage due to sediment clogged stone. Sediment deposits shall be removed and disposed of when the deposit approaches 1/2 the height of the fence or sooner. Accumulated sediment removed from the fence shall be disposed of in locations where sediment will not ~~again~~ erode into ~~the~~ construction areas or into ~~natural~~ waterways/waters of the state. Also, if the filter stone (aggregate for drainage) becomes sediment-clogged and no longer serves as a filter, it may be appropriate to replace it with new stone.

The rock/mesh sediment control fence shall remain in place until areas that drain to the fencing are stabilized and the engineer directs that it be removed. Upon removal, the contractor shall remove and dispose of any excess sediment accumulations, grade and dress the area to the satisfaction of the engineer, and establish vegetation on all bare areas. If the engineer determines that sediment control fence shall remain in place for a period of time after the job is closed out, arrangements will be made by MoDOT Construction personnel for the contractor or MoDOT Maintenance personnel to remove the fence once the area is sufficiently stabilized.

#### 806.8.46.4.6 Inlet Controls

Storm drain (culvert, drop or curb) inlet protection measures prevent soil and debris from entering storm drain inlets. Temporary inlet protection is implemented at existing inlets prior to land disturbance, and new inlets are to be protected as they are put into service. Effective storm drain inlet protection must be provided throughout the project, for all inlets susceptible to receiving sediment, throughout the project until all sources with potential for discharging to an inlet have been ~~paved or~~ stabilized. At that time inlet controls can be removed.

As the conditions or operations change during a project, the sediment control BMP protecting the storm drain inlet may need to be modified to ensure proper effectiveness for sediment filtration and capture. Also, limiting the amount of sediment entering a storm sewer will reduce the need to clean out pipes at the end of the project.

The following types of items are generally considered for use as inlet protection:

Curb Inlet Protection:

- Sand Bags/Rock Socks
- Wattles/Compost Filter Socks/Fiber Rolls/Sediment Logs, etc.
- Various Filter ~~Inserts-Devices and Inserts~~ (e.g., but not limited to, FLEXSTORM Inlet Filters, Silt Saver Inlet Filter, ~~&~~ Big Red Curb Inlet Protector, ~~&~~ Dandy Products ~~(Bag, Saek, Pop, Curb, Curb Bag, Curb Saek)~~)

- Wood, Steel or Other Barricades

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Drop or Pipe/Box Inlet Protection (Should have 9" effective height):

- Rock/Mesh Inlet Check (NEW – see [806.8.4.4.5](#))
- Rock Ditch Checks
- Triangular Silt Dike®
- Sand Bags
- ~~Compost Filter Berms~~
- Various Filter ~~Inserts~~ Devices (e.g., but not limited to, Silt Saver Inlet Filter, & Big Red Area Inlet Protector ~~&~~ Dandy Products (~~Bag, Sack, Pop, Curb, Curb Bag, Curb Sack~~))
- Wood (CBST, as discussed in [806.8.4.4.2](#)), Steel or Other Barricades

*(Note: Item selection may vary depending on the type and design of inlet to be protected and careful consideration should be made with inlet protection to ensure any impounded water will not flood streets, buildings, homes, etc.)*

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As a general rule, geotextile silt fence, especially non-reinforced geotextile silt fence, should not be used as inlet protection, particularly around culvert and drop inlets where high volume, concentrated flows are expected. An exception to this is if a constructed wood or steel frame is erected around the inlet and this frame is then wrapped with geotextile material. In this application, it is recommended for additional support and protection that wire reinforcement be wrapped around the frame and then the geotextile applied over the wire.

Each type of inlet control device (particularly the tubular/cylindrical/triangular products) will have specific directions for installation. In all cases care shall be exercised so as to install the device according to [MoDOT Standard Plan 806.10](#) or manufacturer specifications. Effectiveness may be compromised if not installed correctly.

During construction, elevated curb inlets and median inlets, as well as excavations around inlets, may serve as "riser pipes" as long as they are sufficiently higher (approx. 9" or more) than the existing grade. Sediment that accumulates at the base of the riser pipe following stormwater events shall be removed when it reaches 1/2 of the original height of the riser pipe. Once the desired grade has been achieved and the inlet becomes flush to that grade, subsequent inlet protection is required.

#### **806.8.4.4.7 Temporary Berms — Sediment Control**

**Type C berms** are typically specified at the toes of spill slopes around bridge construction operations and will usually be constructed to the specified dimension (see [MoDOT Standard Plan 806.10](#)). However, dimensions may deviate from those shown on the standard drawings based on site limitations. ~~Also, the straw layer, or erosion control blanket, or geotextile is typically required on the upgrade side of the Type C berm to improve stormwater filtration. This additional filtration layer may be removed if the character of the rock material is sufficient to prohibit contaminated water from reaching the minimize sediment loss from the project stream. In certain construction operations, Type C berms may be used as perimeter protection where significant stormwater flows and/or sediment loading is expected, which would overwhelm silt fence applications.~~ Installation will generally precede land disturbance activities, unless some clearing is necessary in order to gain access to the site. Type C Berms must be installed above the regulatory "ordinary high water mark" ~~and will be installed at the location specified by the engineer. The structure may be permanent or temporary~~ Type C berms are typically temporary, but may be permanent depending on the ultimate desired use of the right of way beneath the bridge. If the Type C Berm is removed, material may be used for bank stabilization, or other construction use. Bank stabilization will be in accordance with

the Section 404 permit. Type C Berms shall be checked for sediment accumulation after each runoff event. Sediment shall be removed when it reaches 1/2 of the original height or before. Sediment removal will include removal and disposition in a location where it will not erode into construction areas or watereourseswaters of the state.

Contract plans will show the general location of the Type C berm, but the precise location of the structure can only be determined at the time of installation and shall be field fit at the direction of the engineer to provide maximum protection, yet enable the installation of piers, bents and other improvement, as well as accommodate for movement of equipment.

*(Note: Oftentimes temporary stream crossings are used in proximity to Type C berms. These crossings can cause gaps in the berm for equipment passage, which could potentially be a conduit for sediment delivery to the waterbody. Use caution when using these two practices in the same location and assure adequate protection of the waterbody. Refer to EPG 806.8.4.3.6 (Temporary Pipes & Temporary Construction Crossings) for more information.)*

**Type A-B Berms** may be used as a temporary perimeter control structure where slopes are less than 2% and permanent vegetation is present on the downgrade side of the structure. They will be constructed to specified dimensions (see MoDOT Standard Plan 806.10) and will be machine compacted with a minimum of one-three passes over the entire width of the berm with a dozer tread, grader wheel, etc. When using a Type B berm for perimeter protection, it should be seeded and mulched with temporary, or, if desired, permanent vegetative cover. When used as a perimeter control BMP, weekly (and post-rainfall/runoff) monitoring inspections will be necessary to identify berm erosion or breaches. Removal of Type **A-B** Berms will occur when grading operations cease and final contours are achieved or when other BMPs have been installed negating the need for the berm. Removal will usually occur just before the application of seed and mulch or other soil stabilization measures.

#### **806.8.4.4.8 Compost Filter Berms-Devices (Mulch-Berms-Included)**

Two categories of compost filter devices are used as erosion and sediment control BMPs on MoDOT projects: compost filter socks/ logs and compost filter berms. (Note: Compost can also be used as a soil amendment and sometimes as a mulch to enhance vegetative establishment.)

Compost Filter Socks consist of compost filter media (compost, or non-treated wood) encased within a three-dimensional fabric tube for purposes of erosion, sediment and pollution control. Compost filter socks are typically used for perimeter protection and are an acceptable alternative to geotextile and other silt fence applications described in EPG 806.8.6.4.4 Silt Fence. Compost filter socks are also acceptable alternate ditch checks as described in EPG, 806.8.4.4.3 Ditch Checks. Specified effective height, as measured in the field, shall apply for both silt fence and ditch check applications. Compost filter socks shall be installed according to the manufacturer's specifications or MoDOT Standard Plan 806.10, including ground preparation and staking requirements. Though compost filter socks are commonly used for perimeter protection and alternate ditch checks, other uses may include: curb and drain inlet protection; slope interruption; protection along the toe of stream and channel banks; on compacted and frozen soils, or pavement where trenching is difficult or impossible; and around sensitive resources where trenching may disturb the resource.

Sediment shall be removed once it has accumulated to one-half the original height of the sock. Compost filter sock shall be replaced whenever it has deteriorated to such an extent that the effectiveness of sock is reduced. Compost filter socks shall remain in place until disturbed areas

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draining to the devices have been permanently stabilized in accordance with the permit. Upon removal of compost filter socks, the wooden stakes should be pulled and the biodegradable netting cut to encourage more rapid degradation. If the netting is non-biodegradable, the netting shall be cut and removed along with the stakes, but the compost filling may be left to further decompose and act as a soil amendment.

Compost or non-treated wood used for compost filter sock filter media (filler material) shall be weed, disease, and pathogen free and derived from a clean source of woody organic matter. Compost shall be produced using an aerobic composting process meeting CFR 503 regulations including time and temperature data. The filler material shall be free of any refuse, contaminants or other materials toxic to plant growth. Test methods for the items below should follow U.S. Composting Council Test Methods for the Examination of Composting and Compost guidelines for laboratory procedures;

- pH – 5.0-8.0 in accordance with TMECC 04.11-A, “Electrometric pH Determinations for Compost”
- Particle size – 99% passing a 2 in (50mm) sieve and a maximum of 40% passing a 3/8 in (9.5mm) sieve, in accordance with TMECC 02.02-B, “Sample Sieving for Aggregate Size Classification”. (Note- In the field, product commonly is between 1/2 in [12.5mm] and 2 in [50mm] particle size.)
- Moisture content of less than 60% in accordance with standardized test methods for moisture determination.
- Bulk density shall be a minimum of 14 lbs/cu ft (dry weight).
- Material shall be relatively free (<1% by dry weight) of inert or foreign man made materials.
- The engineer may request a sample for approval prior to being used and must comply with all local, state and federal regulations.

**Compost Filter Sock Fabric Specifications**

<b>Material Type</b>	<b>5 mil HDPE</b>	<b>5 mil HDPE</b>	<b>Multi-Filament Polypropylene (MFPP)</b>	<b>Heavy Duty Multi-Filament Polypropylene (HDMFPP)</b>
<b>Material Characteristics</b>	Photo-degradable	Bio-degradable	Photo-degradable	Photo-degradable
<b>Sock Diameters</b>	8"	8"	8"	8"
	12"	12"	12"	12"
	18"	18"	18"	18"
	24"	24"	24"	24"
	32"	32"	32"	32"
<b>Mesh Opening</b>	1/8" - 3/8"	1/8" - 3/8"	1/8" - 3/8"	1/8" - 3/8"
<b>Tensile Strength</b>	26 psi	26 psi	44 psi	202 psi
<b>Ultraviolet Stability %</b>				
<b>Original Strength (ASTM G-155)</b>	23% at 1000 hr.		100% at 1000 hr.	100% at 1000 hr.
<b>Minimum Functional Longevity</b>	9 months	6 months	1 year	2 years

(NOTE: all materials must be knitted. Extruded materials not permitted.)

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~~A **Compost Filter berm** Berms is a temporary dike barriers of compost or a compost product that is placed placed along the perimeter of a site, or at intervals along a slope, to control erosion and capture sediment from sheet flow. A filter berm can also be used as a check dam in small drainage ditches as described in EPG 806.8.4.4.3 Ditch Checks. perpendicular to sheet flow runoff to control erosion in disturbed areas and retain sediment. Loose applied compost berms (i.e., mounded compost) should be anchored in place (covered) with ECB for stability. To anchor the compost effectively, place the ECB first and then install the compost along and atop the downgrade edge of the ECB and wrap the ECB over the compost in the direction of flow and anchor with staples or an equivalent.~~

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~~Composts used in filter berms are made from a variety of feedstocks, including municipal yard trimmings, food residuals, separated municipal solid waste, biosolids, wood chips, and manure.~~

~~Compost filter berms can be used in place of a traditional sediment and erosion control tools such as geotextile silt fence. As such these berms are can be installed at the time of clearing and grubbing, or as needed throughout the construction process, and will remain in place throughout construction until the site is stabilized. Weekly and post-runoff inspections will be necessary to identify berm erosion or breeches. Sediment shall be removed once it has accumulated to one-half the original height of the berm.~~

~~Composts used in filter berms are made from a variety of feedstocks, including municipal yard trimmings, food residuals, separated municipal solid waste, biosolids, wood chips, and manure.~~

~~Compost filter berms are generally placed along the perimeter of a site, or at intervals along a slope, to capture sediment from sheet flow. A filter berm can also be used as a check dam in small drainage ditches as described in EPG 806.8.4.4.3 Ditch Checks.~~

Post-construction removal is not required because, by definition, the compost and ECB they are biodegradable and temporary. However, unvegetated berms are often broken down once construction is complete and the compost is sometimes spread around the site as a soil amendment or mulch.

#### 806.8.6.4.9 Mulch Berms

The use of shredded or chipped mulch for berms or temporary groundcover is an acceptable reuse of cleared trees and brush from MoDOT projects. Mulch berms are used for perimeter protection and are an acceptable alternative to geotextile and other silt fence applications described in EPG 806.8.6.4.4 Silt Fence. As such, these devices are used to filter sheet flow and are not appropriate in ditches, drainage channels or other areas of concentrated flow.

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Mulch berms are most effective when piled to a height of at least two feet, preferably installed in existing vegetation, outside of, or at the edge of project clearing limits, so that a buffer of undisturbed soil and vegetation remains on both sides of the berm. Mulch berms will generally be installed at the time of clearing and grubbing, and must be maintained for as long as necessary to contain sediment from runoff. Mulch berms should be installed on the contour when possible to prevent overtopping or overloading at single points.

Mulch berms shall be inspected as part of MODOT's routine inspections. It is also recommended that casual daily inspections be made during periods of prolonged rainfall. Where deficiencies exist, additional mulch, or another appropriate BMP shall be installed as approved or directed by the engineer.

Sediment deposits shall be removed and disposed of when the deposit approaches 1/2 the height of the berm or sooner. A mulch berm shall remain in place until areas that drain to the structure are stabilized in accordance with the permit and the engineer directs that it be removed. Upon removal, the contractor shall remove and dispose of any excess silt accumulations, grade and dress the area to the satisfaction of the engineer, and establish vegetation on all bare areas.

Mulch is biodegradable and need not be removed, unless directed by the engineer. Though not required to be removed, piled mulch should be knocked down and dispersed into a thin layer of ground cover, which will aide in the breakdown of the material.

#### **806.8.46.4.910 Brush Pile Checks/Barriers**

Brush pile checks or barriers are considered to be temporary BMPs that can be effective during clearing and grubbing operations. Piled and compressed tree tops, limbs, stumps and other vegetation, when placed in a "non-jurisdictional" drainage swale or around the perimeter of a land disturbance site, can effectively impound gravel, soil and other eroded materials that otherwise may be carried off of MoDOT right of way during runoff ~~periods~~ events. Brush pile checks are not appropriate for use in jurisdictional (Section 404 of the Clean Water Act) bodies of water.

To be effective, brush piles should be compressed tight to the ground by clearing equipment at the time of installation so there is no void beneath. Brush checks and barriers are only intended to operate as stand-alone BMPs for a very short time period during initial clearing and grubbing, and should be bolstered by the installation of additional supportive measures upgrade or downgrade of the structures, such as sediment basins, sediment traps, ditch checks, etc., as soon as practicable. When these other devices are installed, the brush check/barrier may be left in place as additional filtration, if permissible, or removed.

Like other BMPs, brush piles should be inspected during required inspections to ensure that they are functioning as intended. Initial inspections following rainfall will determine their ability to impound water and sediment. If the brush pile is intended to serve as a longer term sediment control structure for an extended period of time beyond the clearing and grubbing stage, clean out and maintenance equivalent to that required for ditch checks is required.

After land disturbance has been completed, removal should be discussed before heavy equipment leaves the site. In rural situations, and where maintenance issues are absent, the brush pile may be abandoned and left to decompose on its own.

#### **806.8.46.4.10-11 Straw Bales** (MO Specifications [Sec 802](#))

Bales of straw are no longer acceptable sediment control BMPs on MoDOT projects and will not be used as such. Straw is acceptable as mulch when applying temporary ground cover or establishing permanent vegetative cover. Straw used as ground cover is required to be embedded or tackified per Section 802 of the Missouri Standard Specification for Highway Construction.

Straw bales are an acceptable practice used to control concrete diamond grinding residue that is discharged onto MoDOT right of way due solely to the short duration of the discharge. The use of straw bales as sediment control devices should be avoided on MoDOT projects. However, due to the

~~extremely short duration of the operation and the nature of the discharge, straw bales can be used as checks to control discharge slurry from diamond grinding operations~~ as described in EPG [806.8.11](#). During [concrete](#) diamond grinding operations, the straw bales are typically used in concert with other BMPs, including non-structural BMPs such as existing vegetation ~~or mulch~~.

In these situations, bales of straw can be installed as ditch checks and used as a temporary means of controlling pollution by obstructing the flow of the slurry and allowing deposition of the fine cement particles. The bales should be properly staked and extend far enough up the inslope and backslope to sufficiently impound the discharge slurry. The integrity of straw bales must be maintained for as long as they are necessary to contain the slurry. When no longer necessary to control pollution, the bales and other temporary BMPs associated with diamond grinding operations should be removed.

### **806.8.5-7 DISTURBED AREAS**

Project plans that are discussed in EPG [806.8.2](#) Site Description and EPG [806.8.9](#) [Developing/Amending/Updating the Project Plans](#) will identify those areas that will be cleared and graded as part of the highway development project. The plans will also identify areas that are not to be disturbed. Both disturbance and do not disturb areas are generally staked in the field.

On areas of the site where soil disturbing activities will cease and are not planned to resume for a period exceeding 14 calendar days, temporary stabilization must be initiated immediately upon knowing of the 14-day cessation, and must be completed within 7 calendar days. On portions of the project where slopes are greater than 3:1, or greater than 3% and greater than 150 feet in length, all temporary stabilization must be completed within 7 days of ceasing operations. Temporary stabilization may include, but is not limited to the installation of sediment basins, [sediment traps](#), [ditch](#) checks ~~dams~~, sediment fences, and mulch; however, the preferred method of stabilization is seed and mulch.

[Seeding](#) and/or [mulching](#) will be a continuous operation on all cut and fill slopes, excess material (waste), and borrow areas during the construction process. All disturbed areas should be seeded and mulched or otherwise stabilized when and where necessary to eliminate erosion. Seeding and/or mulching shall be done as soon as possible after completion of the earthwork and preparation of the seedbed, weather permitting.

Whenever clearing, grading, excavating or other earth disturbing activities have permanently ceased on a portion of the site, final stabilization must be initiated immediately and completed within 7 calendar days. Final stabilization can be achieved by covering disturbed areas with pavement, buildings or other structures, perennial vegetation or non-erodible materials such as adequately sized rock. With respect to areas that have been seeded, vegetation cover must be at least 70% plant density with uniform coverage over 100% of the disturbed area.

For the purposes of this section, allowances to the 7 day completion period for temporary and permanent stabilization may be made due to inclement weather or adverse site conditions. If ~~utilized~~[used](#), these allowances must be properly documented in the project SWPPP, [and shall including include](#) pictures.

The following types of activities will constitute initiation of stabilization (this list is not exhaustive):

- Prepping the soil for vegetative or non-vegetative stabilization
- Applying mulch or other non-vegetative product to the exposed area
- Seeding or planting the exposed area

- Starting any of the above activities on a portion of the area to be stabilized, but not on the entire area
- Finalizing arrangements to have stabilization product fully installed in compliance with the applicable deadline for completing stabilization

Note: the term “immediately” in this section means as soon as practicable, but no later than the end of the next work day, following the day when the earth-disturbing activities have temporarily or permanently ceased.

## **806.8.6-8 INSTALLATION & REMOVAL**

The contractor shall be required to incorporate all permanent erosion control measures into the project at the earliest practicable time. As stated in EPG [806.8.4.1](#) Construction Requirements, when practical, border, perimeter, or ~~outlet-outfall~~ BMPs to control runoff from disturbed areas shall be installed or marked for preservation before general site clearing. A limited amount of clearing may be permissible to enable the installation of ~~outlet-outfall~~ and perimeter controls. Stormwater discharges from disturbed areas, which leave the site, shall pass through and appropriate impediment prior to leaving the site. It may be necessary to install additional control measures during construction which were not foreseen during the design stage. Temporary ~~erosion-control~~s shall also be used when needed prior to installation of permanent erosion control measures ~~or when needed temporarily~~ to control erosion that develops during normal construction practices, ~~but are not associated with permanent control measures on the project.~~

Temporary BMPs should be removed from the project when areas they are protecting have achieved final stabilization in accordance with the permit. Oftentimes engineers and/or contractors may desire to leave all temporary BMPs in place until project completion and then have one mass removal. Though this practice is not ideal due to increased vulnerability, it is acceptable if the BMPs are continuously inspected and maintained in accordance with the permit until their removal. Also, if the engineer determines that some BMPs shall remain in place for a period of time after the job is closed out, arrangements will be made by MoDOT Construction personnel for the contractor or MoDOT Maintenance personnel to remove the BMPs once the area(s) they are protecting are sufficiently stabilized.

## **806.8.7-9 DEWATERING**

Dewatering of ponds, lakes, coffer dams, pits or excavations associated with construction shall be discussed at the preconstruction conference, and articulated in a written plan, which will outline a method for properly treating the water before it can re-enter a river, stream, pond, lake, wetland, etc. This plan may be amended at any time if changes are necessary.

[Sec 107.10.2](#) requires a dike or appropriate barrier to be placed between the excavation and the stream to prevent sediment from reaching the watercourse. The structural BMPs that are identified in EPG [806.8.4.4](#) Sediment Control Measures are usually sufficient to remove sediment and similar pollutants prior to discharge of return water. Land application of the discharge water is a viable option when percolation into the subsurface results; however, caution shall be used to ensure that water discharge does not cause the formation of gullies in cases where pumping exceeds percolation.

With the possible exception of drilled shafts in large rivers such as the Missouri or Mississippi, return water shall not be discharged without treatment by BMPs that are approved by the engineer. The amount of return water that is pumped and subsequently discharged should be recorded in the project records and expressed as gallons per minute for the duration of the pumping activity.

## **806.8.8-10 ROADWAYS**

In order to ensure that sediment is not transported into a situation where it can be delivered off-site, stabilized construction entrances should be used when construction equipment is frequently crossing or entering paved roadways. Stabilized construction entrances ~~should be~~ typically built with rock of sufficient size to cause mud and dirt to fall off of the tires of the construction equipment. Geotextile fabric may be necessary for placement below the stabilized entrance in some soil

conditions to prevent the rock ~~entrance~~ from subsiding into the soil. In muddy situations, the voids between the rocks will always fill up with soil particles and, as such, additional stone will need to be applied periodically and when repair is required.

The purpose of the stabilized entrance is to reduce the amount of sediment that will be transported onto the driving surface. However, the driving surface at the point of the active crossing cannot remain clean without additional measures such as sweeping or grading.

Because it is impossible to eliminate all trackout of ~~soil particlelessediment~~, inspections should ensure that sediment control measures downgrade from the area of trackout are in good operating condition, especially inlet controls.

On projects where there is one primary construction entrance/exit and a large volume of equipment is expected to pass through this point, a more structural BMP may be appropriate to handle the volume of sediment. If this is the case, rumble strips, cattle guards, or wheel wash stations may be employed to effectively remove sediment. In these situations, routine maintenance will be needed to remove accumulated sediment from beneath and/or around these structures. If a wheel wash system is used, wash water should be channeled to a constructed sediment trap for treatment, unless the system has the capability to recycle the wash water. Just as with other sediment traps, once installed, the location of the trap will be shown on the inspector's site plans. Accumulated sediment shall be removed from the trap when the accumulation reaches 1/2 the height of the structure, or if an excavated pit is used, 1/2 of the original depth.

When accumulated sediment is removed from these BMPs, the material shall be disposed of in locations where sediment will not erode into ~~the~~ construction areas or ~~into natural waterways~~ waters of the state.

### **~~806.8.9 AMENDING/UPDATING THE PROJECT PLANS~~**

~~Erosion control plans are prepared by MoDOT designers and/or consultants. There should generally be two sets of plans developed. One set should be developed to depict existing site topography with outfall and perimeter protection BMPs such as sediment basins, sediment traps, Type C berms, silt fence, etc., that will need to be installed prior to starting land disturbance of the site. The second set will generally show final structural BMPs that are envisioned upon completion of final grading. However, due to project phasing, all of these devices will not be installed until needed, based on site conditions. Therefore, for protection, note on erosion and sediment control sheets that all devices will be installed as necessary based on the discretion of project personnel. Also, create a legend for installation and removal of BMPs and highlight and date devices as they are installed or removed. It is important that SWPPP plans reflect BMPs that are actually on the ground at any given time and so plan sheets shall be properly updated each time BMP additions and/or removals take place on the project. Example erosion and sediment control site plans can be found in Fig. 806.8.9.~~

~~The engineer shall require modifications to the erosion and sediment controls whenever the:~~

- ~~• Design of the construction project has changed in a fashion that could impact the quality of stormwater discharges;~~
- ~~• MoDOT inspections indicate deficiencies in individual BMPs;~~
- ~~• MDNR/EPA notifies MoDOT of erosion and sediment control deficiencies on site;~~
- ~~• Erosion and sediment controls are determined to be ineffective in significantly minimizing or controlling erosion and sedimentation;~~
- ~~• MDNR determines violations of Water Quality Standards have occurred.~~

## ~~806.8.10 SITE INSPECTIONS AND REPORTS~~

~~The resident engineer or inspector is responsible for environmental matters on MoDOT projects. As such, the engineer or inspector shall routinely inspect the condition of erosion and sediment controls and, if allowable due to right of way constraints, the receiving streams shall be inspected for off-site sediment deposits for 50 feet downstream of project outfalls. Routine inspections are to be conducted at a frequency of once every 7 calendar days. Additional, post runoff inspections must occur within 48 hours if the runoff event ceases during a normal work day and within 72 hours, on the next business day, if the runoff event ceases during a non-work day such as weekends or state recognized holidays. A runoff event is defined as an event that causes runoff to occur on the job site and could result from rainfall or snow or ice melt. If there are consecutive days of measurable rainfall and/or runoff, these can be considered one event and precipitation totals should be tracked on a daily basis and an event total recorded. Since these consecutive days are considered to be one event, a post runoff inspection should be done after the rain/runoff ceases; however, general observations should be made daily, especially with regard to outfall BMPs, to ensure BMPs are performing to the desired level. If rainfall or snow/ice melt is not sufficient to cause runoff, inspection reports may not be completed until the next required 7 day inspection. The engineer or inspector will keep a log of all inspections made on the project. Refer to Form 806.8.10, MoDOT Land Disturbance Inspection Record. The engineer or inspector will keep a log of all inspections made on the project.~~

The engineer or inspector will ensure that rainfall measurements are made for the job site and routinely monitor weather forecasts to recognize when predicted weather may threaten the construction site and when runoff has occurred. If the weather forecasts indicate storms may impact the project site, project personnel should evaluate whether or not the site has adequate BMP protection and is prepared to receive runoff.

Areas of the project that meet the final stabilization requirements (i.e., 70% permanent vegetative cover over 100% of the area, rock covered, paved, etc.) no longer require inspection, but casual observations should be made to ensure erosion problems don't arise.

The engineer or inspector shall notify the contractor within 24 hours if any controls are found to be improperly installed, in disrepair, or are not functioning at the desired level of effectiveness. **Any deficiencies noted are to be corrected within seven calendar days;** however, the engineer and other MODOT inspectors may require immediate attention and issue various directives by other means discussed in EPG 806.8.1 Introduction to the Stormwater Permit and SWPPP. Directives to the contractor shall be noted in project records, which shall be available for review by DNR upon request. **In instances where weather conditions make it impossible to correct deficiencies within 7 days, the engineer or inspector will document site conditions in the inspection reports. This documentation will include a written description and pictures illustrating the adverse conditions. As soon as weather and site conditions become favorable, corrections to deficient BMPs shall be made.**

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MoDOT performs environmental compliance training for construction site inspectors, resident engineers, designers and other personnel, including contractors and consultants, to ensure that erosion control inspections are being conducted in a consistent fashion statewide. The individual who performs the training is organizationally located in MoDOT's Environmental and Historic Preservation Section and does not have supervisory authority over the construction personnel who perform inspections. However, the same individual who performs training has the responsibility of

~~performing statewide audits of construction sites to ensure that SWPPPs are being followed to the extent that off-site contamination does not occur. This individual will usually visit every construction site at least once per year and meet with MoDOT resident engineers, inspectors or contractors to evaluate the land disturbance elements of the project and to ensure consistency of inspections. In cases where deficiencies are identified, the resident engineer or inspector has the responsibility to see that the deficiencies are corrected.~~

~~(Note: There are scenarios associated with the use of borrow and excess (waste) disposal areas, as well as portable plants, when the contractor may be responsible for site inspections. Please refer to Fig. 806.8.1 for inspection responsibilities in these scenarios.)~~

### **806.8.11 DIAMOND GRINDING & OTHER SURFACE TREATMENTS**

Although diamond grinding, grooving, and other pavement surface and bridge deck treatments are not land disturbance activities, the fine material that is removed from the driving surface will become suspended in discharge water and has the potential to contaminate nearby streams if not sufficiently managed. The following shall be considered the minimum requirements for performing this work within the project limits in addition to [Sec 622](#) of the *Missouri Standard Specifications for Highway Construction* and [EPG 622.2.1 Construction Inspection for Diamond Grinding of Existing Portland Cement Concrete Pavement](#).

The contractor shall submit to the engineer for approval in writing prior to the pre-construction meeting, the best management practices (BMP's) to be used to protect the environment, including the method of disposal whether on right of way or off-site.

The preferred BMP for [concrete diamond grinding](#) slurry management is land application on MoDOT right of way. When [concrete](#) slurry is dispersed on the right of way, BMP's shall be installed to keep slurry residue from entering drainage structures, ~~from entering any waterways~~ [waters of the state](#), and from leaving the right of way. [At no time should asphalt diamond grinding slurry be discharged directly onto MoDOT right of way. Asphalt grinding residue must be tanked and disposed of properly.](#)

Prior to starting work, [concrete](#) slurry or residue "no discharge zones" will be identified by the engineer with respect to the contractor's approved BMP and residue disposal plan. Special provisions and restrictions will apply when operating in proximity to streams, wetlands, sensitive species habitat and in karst (landscapes with caves) and groundwater recharge areas.

The engineer may suspend operations during periods of rainfall or during freezing temperatures.

### **806.8.12 CONCRETE WASHOUT**

Concrete washout BMPs should be established in designated areas for all projects where concrete production or delivery is occurring. Inspectors should ensure that concrete washout is not occurring in non-designated areas of the project site. These washouts are used to contain residual concrete, concrete associated liquids and the wash water from cleaning trucks, hoppers and chutes, which typically have a high pH and could contain other chemical additives. Washout BMPs can be non-leaking plastic or [clay](#)/bentonite lined pits, a straw bale enclosure lined with plastic, a storage tank or prefabricated BMP or other structure approved by the engineer or inspector. In karst regions of the state, such as the Ozarks, extra care should be taken to ensure proper lining of earthen pits, as cracks and fissures within the bedrock could allow for direct pollution of ground water. Designated



washout areas should be located at least 50 feet away from storm drains, ditches, streams or other water bodies. Washouts should be monitored like other BMPs to ensure there are no leaks and that they are operating effectively. They should be cleaned out when they reach 75% of their design capacity. Care should be taken to ensure these structures do not overflow during storm events.

Upon completion of concrete washout on the project, the engineer or inspector should ensure proper disposal of washout materials. Washout liquids can be allowed to evaporate or be pumped out and properly disposed of. They cannot be discharged into storm drains, ditches, streams or other ~~water~~ bodies of water. Dried concrete can be broken up and used as clean fill on the project, recycled, or properly disposed of by other means.

### **806.8.13 TURBIDITY REMOVAL-REDUCTION & ADVANCED TREATMENT SYSTEMS**

Water clarification and the removal of turbidity will usually require the addition of flocculants, polymers, polyacrylamides (PAM), chitosan and other chemicals that cause soil particles to bind together, become heavy and settle to the bottom of a sediment trap or sediment basin.

Since settling of flocculated soil particles requires very slow moving (still) water, natural and chemical additives should never be introduced into an outfall BMP where water leaves MODOT right of way. In all cases where flocculants are used to reduce turbidity it is essential to include a sediment basin or sediment trap and a ditch liner or ditch check apron that prohibits additional erosion on the downgrade side of the ditch check.

The following Advanced Treatment Systems are options for use in MODOT projects where turbidity removal is required:

Flocculant logs and flocculant flats that are installed directly in a ditch, pipe or culvert upgrade from a sediment basin or sediment trap.

Flocculant treated ditch checks (i.e. fiber rolls, or compost socks/logs) that have been installed upgrade from a sediment basin or sediment trap.

Flocculant treated rock ditch checks installed upgrade from a sediment basin or sediment trap.

Geo ridge ditch checks with attached flocculant bags, installed upgrade from a sediment basin or sediment trap.

Addition of granular flocculants directly into a ditch, upgrade from a sediment basin or sediment trap.

Erosion control blankets and turf reinforcement mats that have been inoculated with flocculants, and installed upgrade from a sediment basin or sediment trap.

## **Chemical Stabilizers**

Chemical stabilizers, also known as soil binders or soil palliatives, provide temporary soil stabilization. Various products are sprayed onto the surface of exposed soils to hold the soil in place and minimize erosion from runoff and wind. These materials are easily applied to the surface of the soil, can stabilize areas where vegetation cannot be established, and provide immediate protection.

Use chemical stabilizers alone in areas where other methods of stabilization are not effective because of environmental constraints, or use them in combination with vegetative or perimeter practices to enhance erosion and sediment control.

Closely follow the manufacturer's recommended application procedures to prevent the products from pooling and creating impervious areas where stormwater cannot infiltrate.

Inspect chemically stabilized areas regularly for signs of erosion, and if necessary, reapply the stabilizer.

**FORM 806.8.104**

MoDOT Land Disturbance Inspection Record



**MISSOURI DEPARTMENT OF TRANSPORTATION  
LAND DISTURBANCE INSPECTION RECORD**

Inspection Date: _____	Inspection Record No.: _____
Project Number: _____	County: _____ Route: _____

Inspection Type: Weekly _____ Final _____	Post-Runoff _____ (Total Precip (in.) _____/Precip Duration (hrs) _____) Other _____
--	---

Total Disturbed Acreage on the Project _____	Total Authorized Acreage on the Project _____
--	---

Are there BMP deficiencies/other matters requiring corrective action, modification or installation within this report?  Yes  No

Land Disturbance Inspection Checklist

		Yes	No	N/A
1	Current and updated SWPPP/site map on site when the erosion & sediment control inspector is on site and a copy given to the contractor?			
2	Permit public notification sign(s) posted and visible to the public?			
3	Are all erosion and sediment control BMPs properly installed, maintained, functioning as intended according to the SWPPP and depicted on the site map? If "No", explain deficiencies below (use add. pages if needed)			
4	Are BMPs in place to protect streams, wetlands and other environmentally sensitive areas from pollutants?			
5	Is trackout controlled at project entrance/exit points?			
6	Are active stormwater inlets susceptible to receiving sediment properly protected?			
7	Does the project have a dewatering plan?			
8	Are dewatering operations effectively removing pollutants from the water?			
9	Are litter, construction debris, fuels, lubricants and other construction chemicals controlled?			
10	Have all temporary BMPs that are no longer necessary been removed and removal depicted on the site map?			
11	Have all deficiencies from the last report been corrected in 7 days? If not, provide an explanation of adverse site conditions and attach photo evidence.			
12	Other:			

Explanation of checklist items identified above (use additional pages if needed): \_\_\_\_\_

Describe areas where land disturbance activities have temporarily or permanently ceased. (Excluding weather shutdowns) Describe how these areas have been or will be stabilized. \_\_\_\_\_

Provide a brief description of the current project status with regard to erosion and sediment control and the effectiveness of BMPs (use additional pages if needed): \_\_\_\_\_

Has the job reached final stabilization in accordance with the permit?  Yes  No

Inspector Name: \_\_\_\_\_ Inspector Signature: \_\_\_\_\_ Date: \_\_\_\_\_

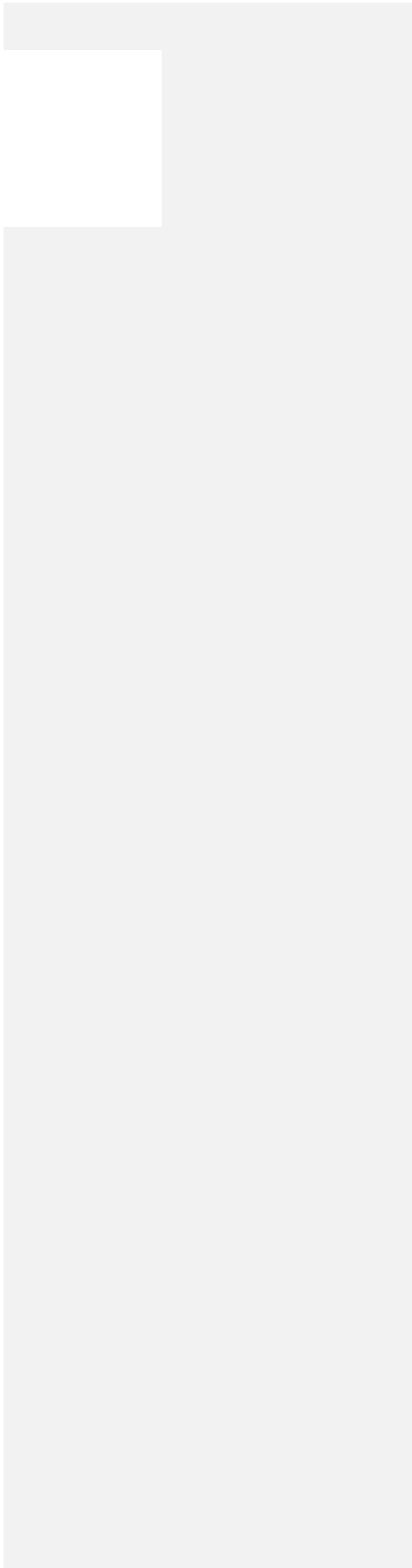
RE Name: \_\_\_\_\_ RE Signature: \_\_\_\_\_ Date: \_\_\_\_\_

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**FIG. 806.8.1**

MoDOT/Contractor Permitting & Inspection Responsibility Guidance Associated with  
MoDOT Construction Projects





## **Land Disturbance Permitting & Inspection Responsibility Guidance Associated with MoDOT Construction Projects**

### **Land Disturbance (LD) on MoDOT Right-of-Way (ROW) or Easements, Including on ROW Borrow & Excess (Waste) Disposal Areas**

- All LD on MoDOT ROW equaling 1 acre or more is permitted by, and must comply with the MoDOT state operating permit for LD and the MoDOT SWPPP
- Weekly and post-runoff inspections are performed by MoDOT inspectors
- BMP maintenance is done by the contractor as directed by the MoDOT engineer and/or inspector

### **Borrow & Excess (Waste) Disposal Areas \*Not\* Located On MoDOT ROW or Easements**

- Contractor must obtain their own operating permit for LD, their own SWPPP and develop their own erosion control plan (site maps)
- Weekly and post-runoff inspections and maintenance of BMPs are performed by the contractor
- MoDOT personnel are encouraged to offer advice on BMP recommendations and placement if the contractor needs support.
- Contractor is responsible for all costs associated with erosion and sediment control.

### **Reference Notes for this sheet:**

1. MoDOT's state operating permit number for LD is MO-R100007
2. Only projects equaling or exceeding 1 acre of LD over the life of the project must comply with permit requirements and the SWPPP. However, regardless of disturbed acreage totals, no project can cause pollution to waters of the state or violate Missouri Water Quality Standards and BMPs will be necessary on all LD projects.
3. The MoDOT SWPPP is comprised of a statewide general narrative document, supplemental site-specific information sheet, project-specific plans (site maps) and all project documentation and correspondence regarding compliance with the MoDOT state operating permit and SWPPP.
4. If the project is operating under the MoDOT permit and SWPPP, MoDOT must provide the contractor with a copy of the permit and MoDOT SWPPP, which will include updated site maps as BMPs are added, removed, or modified.
5. A copy of the MDNR permit public notification sign must be posted at the job's main entrance if possible and must be viewable from the public roadway. An alternate location is acceptable provided the public can see it and it is noted in the SWPPP.

## **Permit Requirements for Concrete and Asphalt Plants**

### **Portable Concrete and/or Asphalt Plants \*Not\* Located On MoDOT ROW/Easements**

- Contractor must obtain MO-G490000 state operating permit to cover this industrial activity and generate their own SWPPP for LD, industrial runoff and wastewater treatment as outlined in the permit.
- Contractor is responsible for all costs associated with pollution control, including erosion and sediment control.

*Note: The MO-G490000 permits both the industrial activity (concrete/asphalt production) and any LD associated with that activity*

### **Portable Concrete and/or Asphalt Plants Located On MoDOT ROW/Easements**

- Since MO-R100007 permits both LD and associated industrial support activities, the contractor can utilize the MoDOT SWPPP to account for the facility; however, amendments will need to be made to the MoDOT SWPPP to cover the industrial activities as outlined in and required by the permit. These amendments may need to include identifying the features of the plant and process specific BMPs on site maps.
- Contractor will be responsible for all required inspections and maintenance of the facility as required in the permit, with quality assurance oversight from the MoDOT engineer and/or inspector
- Contractor is responsible for all costs associated with pollution control, including erosion and sediment control.

**Note: If applicable, the contractor will need to provide MoDOT with a copy of all appropriate permits and/or environmental clearances that have been obtained by the contractor for borrow areas, excess disposal areas and portable plants located on MoDOT right-of-way.**

### **Questions regarding this guidance document can be directed to:**

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**FIG. 806.8.2**

Example Project-Specific SWPPP Information Form



MISSOURI DEPARTMENT OF TRANSPORTATION  
Project-Specific SWPPP Information

Project Number: 0P0230Z County: Pemiscot Route: 84

Project Description: Construct new lanes to expand this route to a 4-lane facility. 4 bridges and one RCB will be constructed as part of this project.

Estimated Project Start Date: April 21, 2013

Estimated Project Completion Date: April 22, 2013

RE Name: Johnny Asphaltseed

Erosion and Sediment Control Inspector(s) Name(s): Dean Martin, Frank Sinatra, Sammy Davis Jr

Primary Contractor(s) Name(s): Real Nice Roads, Inc.

Erosion and Sediment Control Contractor(s) Name(s): Sediment Trappers Extraordinaire

Seed and Mulch Contractor(s) Name(s): We-Seed, Inc.

Total Anticipated Disturbed Acreage for the Project: 72 acres

Primary Receiving Stream(s) for the Project: Rumormill River, Floor Creek, Broken Branch

Location of Public Notification Sign(s) (Note: Must be Viewable to the Public): At intersection of That Road

Additional Project Notes: This project is the second of four phases to complete this corridor.

404/401 Permit Required/Obtained for this Project?  Yes  No

**Attach a map depicting the project location/alignment with enough detail to show waters of the United States within 1 mile of the project.**

**SAMPLE**



**FIG. 806.8.93**

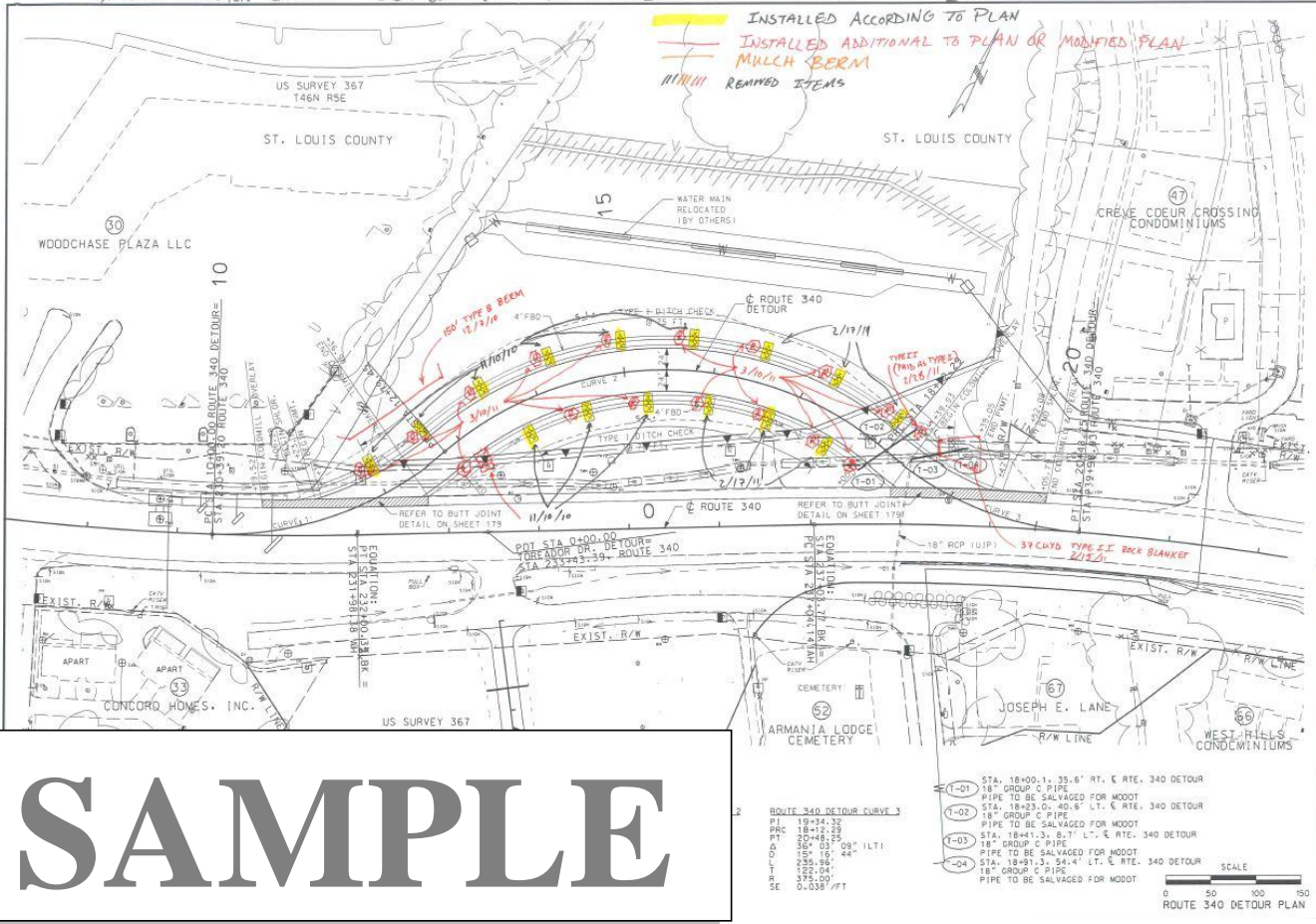
Example Erosion/Sediment Control Site Plans

(Note: Notice the legend, color coding, indemnifying statement and the date of installation and removal of BMPs. Don't forget to label outfalls!)

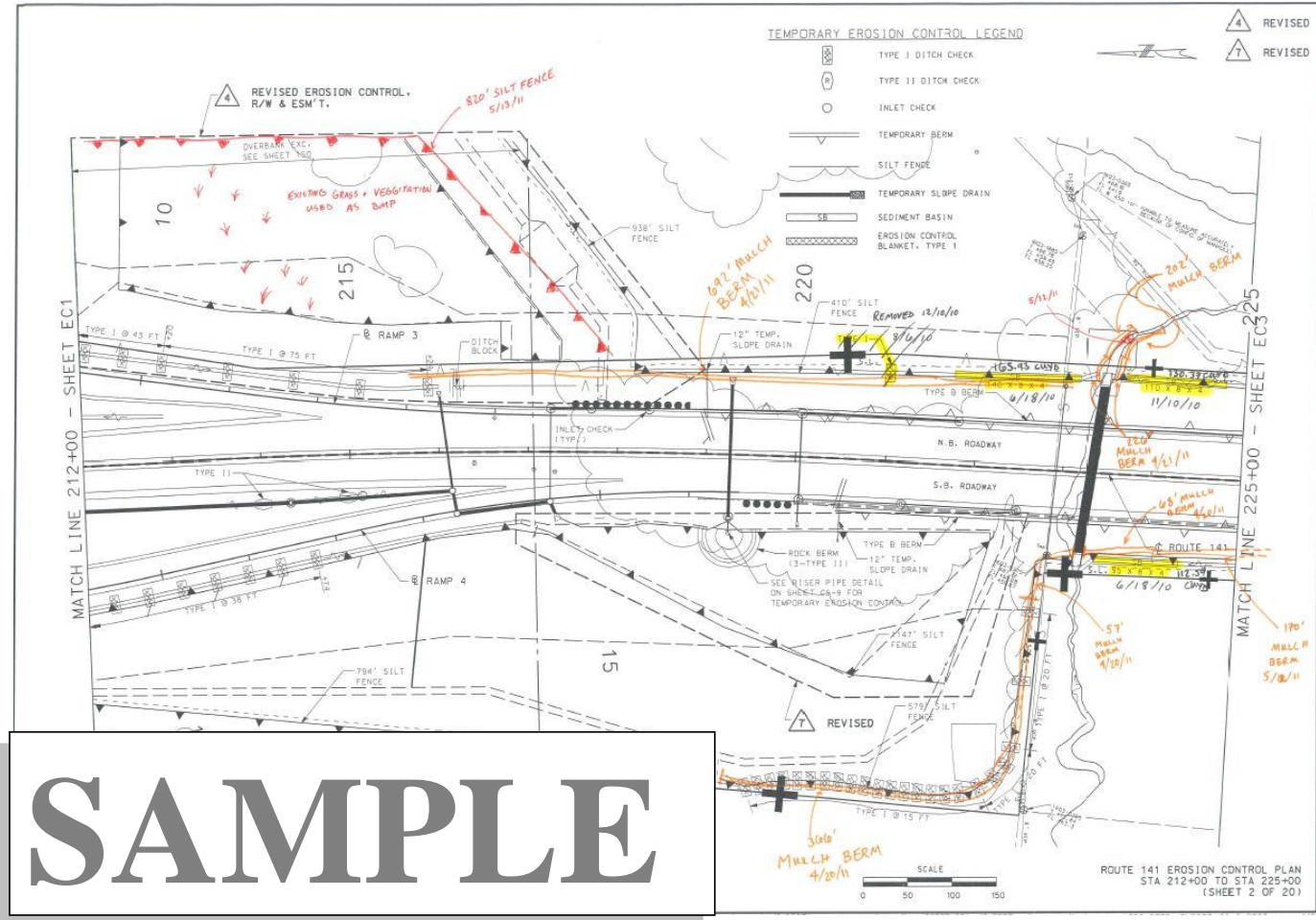




\* ALL EROSION CONTROL DEVICES WILL BE INSTALLED AS NEEDED [REFER TO BOOK 1 FOR MORE NOTES]



**SAMPLE**



**SAMPLE**





**FIG. 806.8.14**

Example of a MDNR SWPPP Evaluation Form

(Note: The following form is used by MDNR to evaluate project SWPPPs, including MoDOT projects. Notice in the “Comment” section it has been identified whether the items they are looking for are located within this written statewide SWPPP, need to be covered on the project specific erosion and sediment control plans (a.k.a., the site maps), or they should be found in both.)



**SWPPP Evaluation**  
**Missouri Department of Natural Resources**

FACILITY INFORMATION	PREPARED BY:		
Name of Facility: _____ MO #: MO-R10 _____ _____ COUNTY	_____ (Name) _____ (Date)		
SWPPP Component	Yes	No	Comments
Facility identified.			Site Map
All outfalls identified			Site Map
All pollutant sources, storm water and non-storm water identified. (porta-pottys, fuel tanks, staging areas, waste containers, chemical storage areas, concrete cure, paints, solvents, other hazardous waste, storage of construction materials, etc.)			Site Map
Contains a physical description of the best management practices (BMP's) both temporary and permanent. This should include how off site vehicle tracking will be addressed.			Narrative SWPPP
Explains site and physical conditions that must be addressed for effective use of the BMP's			Narrative SWPPP
Describes BMP installation/construction procedures, including typical drawings.			Narrative SWPPP/Standard Drawings
Describes operation and maintenance procedures for the BMP's chosen. Include a schedule for maintenance.			Narrative SWPPP
States whether the BMP is temporary or permanent.			Narrative SWPPP
Describes or shows where, in relation to other site features, the BMP's are to be located.			Site Map
Details when the BMP will be installed in relation to each phase of the land disturbance procedures to complete the project and what site conditions must be met before the removal of the BMP's if the BMP's are not permanent. Includes a time schedule for this implementation.			Narrative SWPPP & Contractor Communications
States temporary stabilization details should areas be left undisturbed for more than 14 days.			Narrative SWPPP
States bench marks to be referenced for proper installation, as well as operation and maintenance of drainage course changes. Work in defined drainages or watercourses and their associated wetlands may require a permit from the U.S. Army Corps of Engineers pursuant to Section 404 of the federal Clean Water Act.			Narrative SWPPP
Discusses solid and hazardous waste management including trash containers.			Narrative SWPPP
Discusses proper sanitation methods (i.e. portable toilets).			Narrative SWPPP
Explains how the storage of construction materials will be kept away from drainage areas.			Narrative SWPPP
Describes the outlet control devices to be used.			Narrative SWPPP/Site Map
The SWPPP shall require a sedimentation basin for each drainage area with 10 or more acres disturbed at one time. The sediment basin shall be sized to contain a volume of at least 3600 cubic feet per each disturbed acre draining thereto. Accumulated sediment shall be removed from the basin as needed to ensure the minimum volume of 3600 cubic feet is maintained. Discharges from the basin shall not cause scouring of the banks or bottom of the receiving stream. The SWPPP shall require the basin be maintained until final stabilization of the disturbed area served by the basin.			Narrative SWPPP

SWPPP Component	Yes	No	Comments
Where use of a sediment basin of this size is impractical, the SWPPP shall evaluate and specify other similarly effective BMPs to be employed to control erosion and sediment delivery. These similarly effective BMPs shall be selected from appropriate BMP guidance documents authorized by this permit. The BMPs must provide equivalent protection.  The SWPPP shall require both temporary and permanent sedimentation basins to have a stabilized spillway to minimize the potential for erosion of the spillway or basin embankment.			Narrative SWPPP, Basins to be Shown on Site Map
The SWPPP shall be amended when appropriate. Field implementation shall match narrative and illustrated depictions.			Update Narrative SWPPP & Site Maps
The SWPPP shall contain a site inspection form and inspection log for use during weekly inspections or during storm water events. Inspections shall be performed once every 7 days or within 48 hours after a storm event that causes storm water runoff to occur <b>on site</b> . Qualified personnel shall perform inspections and authorized persons shall sign reports. The site inspection shall include (at a minimum): inspector's name, date of inspection, observations relative to the effectiveness of the BMPs, actions taken or necessary to correct the observed problem, and listing of areas where land disturbance operations have permanently or temporarily stopped. The inspection report shall be signed by the permittee or by the person performing the inspection if duly authorized to do so. Copies of inspection reports shall be maintained for three years from the date permit coverage expires.			Narrative SWPPP EPG Form 806.8.10 (MoDOT Land Disturbance Inspection Record) & Inspection Records
The SWPPP shall indicate the portions of the project for which each operator has control over day-to-day activities.			Site Map
Contractors shall be notified of the provision of the SWPPP and a copy shall be provided to all contractors or sub-contractors involved with pre-stabilization activities. A provision must be included to notify all applicable contractors of changes made to the SWPPP.			Narrative SWPPP/Cover at PreCon
The owner as well as all relevant contractors and sub-contractors shall sign the SWPPP.			Contracts/Specs Say Environmental Laws will be Followed
<b>SITE MAP</b>			
In addition to the narrative portion of the SWPPP, a site map shall be included. The site map shall be a maximum of 1"= 200 feet. Applicable topographic lines shall be shown. The site map shall include:			
Drainage patterns and slopes anticipated before and after major grading activities are completed.			Site Map
Show offsite materials, waste, borrow or equipment storage area, surface waters.			Site Map (Only if Possible)
Boundary lines for land disturbance activities.			Site Map (Typically Slope Limits)
Existing and planned streets, buildings, lots, utilities, geographic features, buffer strips and waterways.			Site Map (Always on <del>Our</del> Plans)
All outfalls labeled.			Site Map
All BMP's both temporary and permanent.			Site Map
All sedimentation basins.			Site Map
The map shall include a legend, which describes all symbols used. Whenever symbols fail to satisfactorily convey the requisite information, notes shall be used.			Site Map (See <a href="#">Fig. 806.8.9</a> Maps)
Comments:			



**FIG. 806.8.15**

Imhoff Cone & Turbidity Tube Testing Procedures

(Note: The current MoDOT state operating permit for land disturbance does not require sampling of either settleable solids or turbidity.)



### Imhoff Cone Testing Procedure for Settleable Solids

(Developed by the Nebraska WEA, [http://www.ne-wea.org/LabManual/settleable\\_solids.htm](http://www.ne-wea.org/LabManual/settleable_solids.htm))

#### Procedure

1. Fill an Imhoff cone to the one-liter mark with a well mixed sample.
2. Allow sample to settle in the Imhoff cone for 45 minutes.
3. Gently stir the sample with a glass rod to release the suspended matter clinging to the sides of the Imhoff cone.
4. Let sample settle for an additional 15 minutes.
5. At this point, one hour has passed. Record the volume of settleable solids (in milliliters/Liter/hour) in the Imhoff cone.

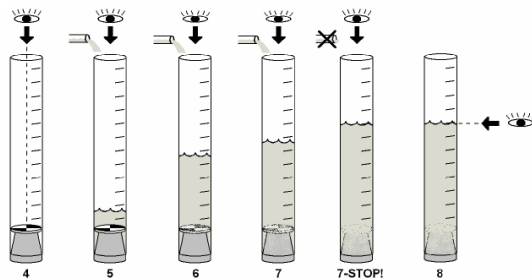
Note: Do not include any floating solids or any voids in the settled solids as settleable matter.

### Turbidity Tube Testing Procedure for Turbidity

(Developed from the SOP for Turbidity Measurements Using Turbidity Tube, Rev. 1, Utah DEQ, DWQ, 2011, as well as Myre, E., & Shaw, R. (2006): The Turbidity Tube: Simple and Accurate Measurement of Turbidity in the Field, Michigan Technology University, Michigan )

#### Procedure:

1. Collect a water sample in a large, clean container (bucket/jug/jar). Be careful not to include sediment from the bottom of the body of water.
2. Rinse the tube with the water that is going to be tested and pour it out.
3. Stir or swirl the water sample in the container vigorously until it is homogenous, introducing as little air as possible.
4. Place your head 10 to 20 centimeters directly over the tube so that you can see the viewing disk while the sample is being poured into the tube.
5. Slowly pour water into the tube. Try not to form bubbles as you pour. *If bubbles do form:* Stop pouring and allow any bubbles to rise and the surface of the water to become still.
6. Keep slowly adding water until the pattern on the disc becomes hard to see.
7. Watch the viewing disk closely and add water even more slowly. Stop pouring as soon as the pattern on the disk can no longer be seen. *If you can still see the viewing disk pattern when the tube is full:* Record the turbidity value as less than the final measuring mark. (Example: If your tube is full and your highest mark is 5 NTU, write down that the turbidity is "<5 NTU".)
8. Read the turbidity from the scale on the side of the tube. *Remember:* If your turbidity tube does not have turbidity values marked on the tube side, simply measure the water level with a ruler or tape measure and find the corresponding turbidity value in the table on the following page. Clean the tube and disk.



Schematic of turbidity measurement using a Turbidity tube (Myre and Shaw, 2006)

### Length-to-Turbidity Conversion Chart

The following table provides the turbidity values (in NTU) that correspond to different lengths measured above the viewing disk. These values can be used to mark the turbidity tube directly or to convert measured values to turbidity units.

Table 1: Conversion chart converting centimeters (cm) to turbidity units (NTU's). Table and equation 1 from Wyoming Stream Team, 2011.

Distance from bottom of tube (cm)	NTU's
<6.25	>240
6.25 to 7	240
7 to 8	185
8 to 9.5	150
9.5 to 10.5	120
10.5 to 12	100
12 to 13.75	90
13.75 to 16.25	65
16.25 to 18.75	50
18.75 to 21.25	40
21.25 to 23.75	35
23.75 to 26.25	30
26.25 to 28.75	27
28.75 to 31.25	24
31.25 to 33.75	21
33.75 to 36.25	19
36.25 to 38.75	17
38.75 to 41.25	15
41.25 to 43.75	14
43.75 to 46.25	13
46.25 to 48.75	12
48.75 to 51.25	11
51.25 to 53.75	10
53.75 to 57.5	9
57.5 to 60	8
Over 60	<8

$$\text{Depth in Centimeters} = 244.13 * (\text{Turbidity in NTU})^{-0.662} \quad (1)$$

